Electrical World

The Consolidation of Electrical World and Engineer and American Electrician.

Vol. XLVIII. NEW YORK, SATURDAY, OCTOBER 27, 1906. No. 17.

PUBLISHED WEEKLY BY THE

Mc Graw Publishing Company

114 Liberty Street, New York.

Telephone Call: 7605 Cortlandt. Cable Address Electrical, New York.

Edited by T. C. Martin and W. D. Weaver.

Chicago Office.....1139 Monadnock Block
Philadelphia Office.....Real Estate Trust Building
Cleveland Office.....1015 Schofield Building
European Office.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico.....Per year, $3.00
Foreign Countries, within the Postal Union.....$6.00
25 shillings. 25 marks. 25 francs.

Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to September, 1904, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Entered as second-class matter at the post office at New York, N. Y.

Of this issue of the Electrical World *18,000 copies are printed. Total circulation for 1906 to date, 793,000, an average of 18,442 per week.*

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The Street Railway Convention.

We close this week our report and review of the convention just held by the street railway interests of the country at Columbus. It is agreeable to be able to register a complete success in every respect. It must be remembered that this was the first convention of the American Street and Interurban Railway Association with a new constitution and a federalized basis of operation, and it is easy to imagine many ways in which the convention could have failed of its purposes. But from first to last a well-conceived programme was carried out vigorously and smoothly; the papers and discussions were generally of a high order of merit, and the attendance was once more a record-breaker; while at the same time the entertainments of the occasion were not allowed to swamp out of sight the real serious business for which so many people had been brought together. Mr. Caryl Ely, who has done such splendid work during the past few years, and has left deep his imprint on the affairs of the associations, finds a worthy successor in Mr. John I. Beggs, and it may be taken for granted that during the present term the work of the enlarged association will be at once solidified and extended, for Mr. Beggs is nothing if he is not an efficient executive and a born administrator.

The educational work of the body from the technical standpoint was, of course, embraced chiefly in the topics and discussions of the engineering association, which covered a wide range including power houses, cars and car equipment, tracks and lines and transmission cables. Moreover, it was shown that during the year a great deal of progress had been made toward standardization and the accumulation of data whose very collection must tend toward uniformity in practice and in the art. The exhibits themselves were also a most interesting and pleasing study from the engineering standpoint, and exemplified that in the midst of growing uniformity and, in fact, because of it, the possibility has been attained of making further steps forward in refinement and perfection. In these improvements and economies the public shares with the operating traction companies; and the association, standing as it does for an immense aggregation of capital, reaching now over $3,000,000,000, stands equally for the comfort and convenience and welfare of the whole public of the country; for street railway travel is no longer confined to urban limits, but is a boon to the remotest farmer in almost every rural district of the country.

The Work of the Reichsanstalt in 1905.

Our esteemed British contemporary, *Engineering*, has recently published an excellent summary of the work reported by the president of the Reichsanstalt as accomplished during the year 1905. One has only to glance at the volume and character of this report to recognize the value of the service which Germany has given, and continues to give, to the physical and mechanical sciences, both pure and applied. It is a matter for congratulation that Germany is not unaided in this work, and that Great Britain and America are likewise taking active independent shares, the former in its National Physical Laboratory and the latter in its National Bureau of Standards. The electrical researches reported upon relate to standard resistance wire stand-

ard cells, electrometers, frequency meters, wave length meters and other subsidiary apparatus.

It is stated that manganin has, after fourteen years' experience, given, on the whole, full satisfaction as a resistance material. It is not only very nearly constant in resistivity during transport, but its temperature coefficient is only 0.001 or 0.002 per cent per degree Centigrade; moreover, its thermoelectric force against copper is very low. For these reasons manganin is easily the best known substance for use in the construction of resistance coils of precision. It is reported that the size of the crystals of mercurous sulphate appearing in standard cells has been found to exert a minute but appreciable influence upon the electromotive force of the cells. The exact cause of the phenomenon remains obscure. It has been found desirable to use very fine strips, instead of very fine circular wires, of platinum in the suspensions of movable parts of electrometers. Such strips have been obtained by rolling Wallaston silver wires, provided with a central platinum core. Such strips are stated to be as strong as cylindrical wires of the same cross-section, but are less subject to vagaries of twist.

Some interesting results are reported on the analysis of complex alternating wave forms into component harmonics by electric resonating sieves, which method is described as being more sensitive and convenient than the purely mathematical method. A curious new method of measuring the frequency of high alternating e.m.f's is described. The voltage terminals are immersed in an insulating liquid, such as kerosene oil, and a system of tremor waves is observed to be set up on the surface of the oil, due to alternating electrostatic actions. By means of a stroboscope the frequency of these waves on the surface of the oil can be determined experimentally. For those interested in the measurement of the wave lengths of wireless telegraphy, a research is recorded on apparatus capable of measuring waves up to 520 meters in length.

Thermo-Electric Batteries.

Very shortly after the development of the first voltaic cell came the discovery of the thermo-electric element. The voltaic battery has, however, come into extensive use during the last hundred years, whereas the thermo-electric battery has made hardly any progress and is still regarded as a more or less scientific curiosity. Thermo-electric couples are utilized in various ways for the purposes of physical measurement, but there are very few thermopiles that yield power to the extent of one watt, while a dekawatt is almost unknown to thermo-electric generators. One reason for this backwardness of the thermo-electric battery is the limited voltage of each individual couple. The limit is about a decivolt under practicable working conditions, whereas two volts is readily obtainable from a voltaic cell. The very low voltage of a thermo-electric couple would not prevent a development of considerable power, if the internal resistance could be reduced as the square of the voltage. But the resistance of thermo-electric batteries has always been very appreciable. Several attempts have been made in the past to develop thermopiles for industrial service. The difficulty which they presented has usually been the melting or destruction by heat of some of the elements after a short period of service, so that they came to be regarded as unreliable. Nevertheless, if a thermopile could be constructed at a reasonably low rate, and would not burn out in service, it would have a distinct field of utility for low-voltage work. Such a thermo-electric battery would certainly be a dry battery in the true sense.

A paper was recently read by Mr. A. Heil before the Karlsruhe Elektrotechnischer Verein on a new type of thermo-electric battery, which claims to be worthy of practical consideration on a small scale. A battery of some 200 elements heated by a gas burner, or small coal stove, is stated to give 18 to 20 volts internal e.m.f., with 3.5 ohms total internal resistance hot, and to deliver steadily 2.5 amp. at about 10 volts, or a useful output of 25 watts at a consumption of 15 to 20 liters of illuminating gas per watt-hour, or of 20 grams of coal. There seems to be very little hope of obtaining electric energy on a large scale directly from thermo-piles, although at first sight one would suppose that such a process should be economical, by dispensing with the engine and dynamo in the ordinary steam-electric power plant. Even supposing that a suitable and durable thermo-electric couple could be designed for electric power delivery on a large scale, it is clearly necessary that there should be a relatively large difference of temperature between the alternate hot and cold junctions. In an ideal thermo-generator, heat energy would be absorbed at the hot junctions, and rejected in lesser amount at the cold junctions, according to efficiency laws substantially similar to those of heat engines. But unfortunately this is not all. In order to keep down the electric resistance of the thermo-generator, the couples must be short and thick. This means, however, that they will conduct heat well also. Consequently, when the working difference of temperature is applied to their junctions, there is not only a transfer of heat from the hot to the cold junctions usefully delivering a certain proportion of electric power in the process, but there is also a large accompanying transfer of heat by pure metallic conduction, which is wholly wasteful.

The Simplon Tunnel Plant.

It was of course a foregone conclusion that when the huge Simplon Tunnel was completed electric traction would be used in it. It certainly would have been almost unthinkable at the present day to have used steam locomotives. It is, however, perhaps rather a surprise to American engineers to find the three-phase system which they have here solemnly cast into outer darkness adopted for this extremely important work. To be sure, the necessities of prompt delivery had an important bearing on the situation, and it was very convenient to be able to benevolently assimilate some of the Valtellina locomotives; but had the exigency occurred here we can easily imagine the pressure that would have been brought to bear in favor of "standard" third rail equipment. However, Brown, Boveri & Co. have long had a habit of doing the unexpected and doing it successfully, and the result of their efforts in this case is a highly interesting plant. The system used is practically that which has already proved successful on the Valtellina line; the power stations, hydraulic, are the same that helped cut the great tunnel, and the transmission of twelve miles through the *penetralia* of the mountains is of the simplest possible description.

Coming now to the locomotive, one realizes that it is no plaything. It weighs 62 tons and has a maximum drawbar pull of 31,000 lb. There are six driving wheels and two motors, both driving the middle axle by means of a coupling bar. The outer drivers are similarly connected to the middle one. Thus, while the motors are gearless they are not keyed to the driven axle. Each motor has a rating of 450 hp and can work up to 1,150. The drive chosen strikes one as simple and ingenious, but hardly suitable for American roadbed. The method of speed regulation

is perhaps the most striking characteristic of the machine. The usual difficulties in getting varying speed with three-phase motors are well known. Rheostatic control is effective, but wasteful. The "cascade" connection, on the other hand, is fairly efficient, but bad in the matter of power factor. In these locomotives a six-phase secondary is used such as will fit either an 8-pole or 16-pole field, and the primaries are used in a mesh-star combination to give a polar structure with normal speeds of 224 and 112 r.p.m., respectively. Unquestionably the former gives materially the better result, but no data are at hand to show how much better. Later we shall hope to get test data that will show this.

If the pole changing device is really worked out it will be of great advantage in general three-phase work. One may fairly infer from its use in this case that it is better than the cascade arrangement—but how much better? It would certainly work out better in a geared motor than in one for such very low rotative speed as on these locomotives. The secondaries are, of course, provided with resistances, and both these and the reversing and pole-changing switches are operated from simple controllers, the resistances directly and the switches by compressed air. The rotor resistances are kept cool by blowers when in use. An interesting safety precaution is the enclosure of all high-tension devices in a metal case which can be opened only when the bow trolleys are out of contact with their conductors. Altogether, the whole equipment strikes one as simple and workmanlike, probably the best, as it is the latest, example of heavy work with three-phase motors. The necessary use of two collectors is, of course, heretical from the American standpoint. Perhaps a little better acquaintance with the bow trolley will lessen the fear of duplication, on the hypothesis that one wheel is as bad as two bows. At all events it is safe to predict that the Simplon plant will do its work well.

The Distribution of Illumination in the Neighborhood of a Row of Lamps.

The illumination of large rooms in a graceful, effective, pleasing and economical manner, is an undertaking which may often fully task the powers of the illuminating engineer. The duty has often necessarily been performed in an empirical and haphazard fashion. For want of adequate data on the subject it has been often deemed sufficient to estimate a reasonable number of total candles, on the basis of floor space, to distribute the corresponding number of incandescent lamps in a fairly decorative manner, and then to trust to luck that the resulting effect will be satisfactory. One reason for the above slipshod method of following the path of a definitely prescribed problem is the great complexity of the general subject of illumination from a number of scattered sources. Granting that the law of inverse squares gives a simple arithmetical rule for dealing with a single point source, yet when we have to deal with dozens or even hundreds of lamps, the arithmetical complexity of the case presented in a large hall is so great that it does not pay to work out the summation. If tables could be offered, by reference to which the total illumination at any point in a room or hall could be found for a given number of candles, in a reasonably simple geometrical distribution, there can be no doubt that the technical estimates of an illuminating engineer would be increased in precision.

The article by Mr. J. R. Benton on page 805 of this number attempts to bring order out of chaos, and to offer conveniently tabulated data for the particular case of a hall lit either by a single row of incandescent lamps near the ceiling, or by a pair of parallel rows. The formulas, which are derived on the basis of a perfectly uniform linear distribution of numerous small light sources in a row, are somewhat formidable in appearance. They lead, however, to tables of convenient form for reference. They form a useful addition to the subject of quantitative illumination in distributed lighting. An examination of the tables, and the curves of Fig. 2, brings out clearly the small difference between the illumination due to a single point and the illumination due to a uniformly luminous line, at distances of the length of the line or greater. That is, if we consider a line of lamps, say 10 meters long, the maximum illumination which will be produced beneath it, at a distance of 10 meters or more from its center, will be practically the same as if all of the lamps were collected into one total source at the center of the line. The table 1 shows, in fact, that if a 10-meter row of lamps was placed along a ceiling, the maximum direct illumination at a point below, 10 meters from the center of the row, would be equal to that from a single massed source at the line center when the angle of depression was 53°. For a depression angle of 90°, or vertically below the center of the line, the illumination would be 10.6 per cent less than that due to the massed central cluster, while at a depression of 30°, which would be nearly the usual practical limit, the illumination would be 16 per cent more with the row of lamps than with the massed central cluster. At distances from the line center greater than its length, these deviations from the central cluster illumination are seen to grow less, while for shorter distances they become greater. Even, however, at a distance from the line center equal to half its length, the differences are not very great; at 45° depression, the difference would disappear. At 30° depression the line would give 42 per cent more illumination than the central cluster; and, at 90°, or vertically below, 29 per cent less. From this it is to be inferred that unless the length of a hall is large by comparison with its height, the maximum direct flow illumination produced by rows of lamps along the ceiling will not differ very greatly from that produced by the same number of lamps in a bunch at the middle of the ceiling.

It is to be noted, however, that the propositions are confined to direct illumination, or to what might be called equivalent outdoor illumination under a cloudy sky. In other words, the effect of reflection is ignored. In practice, however, with light wall papers, ceiling tints and textile hangings, the indirect or reflected illumination is at places greater than the direct illumination. The numerical error in the estimate of illumination at a corner of a hall due to ignoring reflected or indirect light may be much greater than the error made by assuming all the lamps to be collected into a central ceiling cluster. To carry the proposition to an absurd excess in the opposite direction, we have only to remember that a single candle in a room having walls, furniture, floor and ceiling, assumed of perfectly reflecting material, would produce indefinitely powerful illumination everywhere, or infinite candle-meters. Even the brightest walls and ceilings are very imperfect reflectors, but they greatly modify the total illumination, so that what we need are not only tables and data for the geometry of direct illumination as in the article here considered, but also tables and data for the modifying influence of walls and ceilings of definitely measurable reflective coefficient. We can, of course, work out a problem of illumination on the basis of direct illumination only, and having in this way provided adequate illumination everywhere, throw in the indirect illumination as a bonus, or factor of safety. That is magnificent, but it is neither economy nor precision, even though it be the best we can do at present.

The Columbus Street Railway Convention.

With the largest attendance in its history, the largest budget of papers ever presented and the most extensive collection of exhibits in the commercial department ever attempted, the Columbus conventions of the American Street and Interurban Railway Association and its affiliated and allied bodies have established a record that will put future administrations on their mettle to maintain, and to excel will indeed be a triumph. Elsewhere is presented a list of the officers of the various associations who were elected.

Mr. John I. Beggs first came into prominence in the electrical field in connection with the development of the old pioneer Edison electric lighting interests at Harrisburg, Pa., where he was already engaged in the insurance business. The results obtained by him in the development of the property were, it is said, unequalled by any other early Edison company, with the result that Mr. Beggs was brought to New York City to duplicate his successful work. While in New York the system grew rapidly under his care, and a great feature was the attention given to the installation of electric motors, which were exploited and introduced with the courage and vigor that has always characterized Mr. Beggs in his management. For many years past Mr. Beggs has been intimately connected with the growth of electrical interests in Milwaukee, where he is to-day president of the Milwaukee Electric Railway & Light Company, which virtually controls the systems in that leading Western city. Mr. Beggs has also had an active share in the work in St. Louis,

PRESIDENT JOHN I. BEGGS.

where he is president of the United Railways. As manager of the Union Electric Company of St. Louis, he carried out successfully the contract for supplying 10,000 hp. to the Louisiana Purchase Exposition in 1904. Another evidence of his skillful direction of affairs was found in his receivershp and presidency of the National Electric Company of Milwaukee during the past two years. Mr. Beggs is also identified with many other commercial and financial interests, and is a director in the North American Company, which administers the electrical properties referred to in Milwaukee, St. Louis, and elsewhere. Mr. Beggs has always evinced the deepest interest in association matters, and his active participation in the convention of the Street Railway Assocation, the National Electric Light Association, and other bodies, is familiar to all the readers of this journal. The election of Mr. Beggs to the presidency of the American Street and Interurban Railway Association is characteristic of the turn that events have taken in that representative and influential body; and, as he is in sympathy with the progressive forward policy of Mr. Ely, there is every reason for the assurance that in his hands the useful work of the Association will be advanced and its influence be felt in every branch of the street railway industry.

Last week a brief account was given of the convention of the American Street Railway Association at Columbus, together with abstracts of several of the papers read at the meetings. We give below abstracts of the discussions which followed the reading of these papers:

In discussing the paper by Mr. H. G. Stott on "Underground Cables," Mr. W. B. Reed stated that the first high-potential cables were laid in New York in 1886, and, although these cables were not provided with lead sheaths, they operated for 14 years without any trouble. He expressed the opinion that rubber-covered cables are excellent for damp places, provided a good quality of rubber is used. Mr. Paul Winsor related his troubles with return currents in lead sheaths. The difficulty was overcome by cutting away the sheath for a short distance at certain points. Mr. H. N. Latey explained the insulated negative cables used in the New York Subway. Although there is a potential difference of about 60 volts between points on the return rail and the sub-station bus, there is a difference of potential of only about 6 volts between the return rails and the pipes in the immediate vicinity. Mr. C. S. Kimball said that difficulty found in the grounding of lead sheaths in Washington had been due to the cement lining of the iron ducts, which becomes brittle and cracks and separates from the iron. The iron ducts are being replaced as rapidly as circumstances will permit.

The paper by Mr. Walter Goodenough on the relative economy of steam turbines and engines at various percentages of ratings was discussed by Mr. Winsor, who did not agree with the author as to the effect on the economy of operating the units at certain loads. The operating engineer should not take into account the question of fixed charges, but should at all times attempt to keep the cost of operation at the lowest possible figure.

The paper by Mr. E. C. Spring on interurban freight and express was discussed by Messrs. G. W. Parker, Ernest Gozenbach, G. B. Hippee, H. M. Brinckerhoff and P. P. Crafts, each of whom expresses an opinion favorable to the handling of freight and express by interurban railways. The papers by Mr. H. M. Brinckerhoff and Mr. E. P. Roberts on heavy and light electric railways, respectively, were not discussed.

A paper by Mr. E. H. Anderson dealt with the dynamic features of car service and their effect on the cost of that service. It was shown that by closely examining a composite service of city and interurban running it is possible to determine the proper speed equipment for the combination service which will have the least cost per car-mile. By assuming certain road conditions and equipments, it was shown that should the earnings per seat-mile be approximately the same for the interurban car as for the city car, the interurban railway should pay handsome dividends, whereas the city system will struggle for life. Mr. N. W. Storer said that much money has been wasted and many equipments have been given bad reputations simply because of the selection of improper gear ratios. Much of the trouble experienced from the slipping of wheels may be overcome by the adoption of the multiple-unit control equipments for street cars with automatic acceleration. Mr. E. D. Priest stated his belief that it would be greatly to the advantage of both the consumer and the manufacturer if they would consult each other with reference to the service requirements before selecting the size or type of motor. Mr. E. W. Olds remarked that operating men often select an equipment for from 40 to 60 miles per hour, when as a matter of fact the speed does not average more than 25 miles per hour. As a consequence the motors are overworked and very often burn out.

Western Society of Engineers.

The electrical section of the Western Society of Engineers, Chicago, will probably revive an old practice which several years ago resulted in some very successful meetings and in the promotion of acquaintance and good fellowship among its members. This plan is to have dinner served at some down-town restaurant immediately after business hours and proceed with the discussion of technical matters after dinner. In this way there is more opportunity for getting acquainted and the exchange of information and the meetings adjourn much earlier than when held at 8.30 as is usual. The next meeting will be held November 16, when the plant of Sears, Roebuck & Co. will be described by Mr. M. C. Schwab, of Adams & Schwab, consulting engineers.

Dedication of the New Engineering Building at the University of Pennsylvania.

The dedicatory exercises connected with the acceptance of the new engineering building of the University of Pennsylvania by the Board of Trustees, which served to mark October 19 as a red letter day in the history of the university, were of more than ordinary interest to the engineering profession. A brief notice of the exercises and a description of the building were given in our last issue.

In addition to the usual addresses of presentation and acceptance of the building the occasion was marked by the recognition of a number of engineering societies and government engineering branches. The honorary degree of Doctor of Science was conferred on their heads as follows:

American Institute of Electrical Engineers, President Samuel Sheldon; American Society of Civil Engineers, President Frederick P. Stearns; American Society of Mechanical Engineers, President Frederick W. Taylor; Brigadier-General Alexander Mackenzie, Engineer-in-Chief, U. S. Army; Rear-Admiral C. W. Roe, Engineer-in-Chief, U. S. Navy.

The same degree was also conferred upon Marie M. H. Vetillart, harbor engineer of Calais, France, and Senor Ramon Ivarrola, who represented the French and Mexican Governments, respectively, at the dedication; Prof. Henry W. Spangler and Prof. Edgar Marburg, University of Pennsylvania; Prof. Mansfield Merriman, Lehigh University; Mr. Samuel M. Vauclain, Baldwin Locomotive Works, and Mr. John Fritz, Bethlehem Iron Works.

The principal addresses were delivered by Prof. Alex. C. Humphreys on "The Engineer as a Citizen," and Dr. Frederick W. Taylor, who spoke on "A Comparison of University and Industrial Discipline and Methods."

Dr. Taylor pointed out the defects found in young technical graduates. For a period of from six months to two years after graduating they are, generally speaking, discontented and unhappy. They are apt to look upon their employers as unappreciative, unjust and tyrannical, and it is frequently only after changing employers once or twice and finding the same lack of appreciation in all of them, that they start upon their real careers of usefulness.

On the other hand, the attitude of employers toward young graduates is fairly expressed by the following written instructions given for the selection of quite a large number of young men to fill positions which presented opportunities for rapid development and advancement. These instructions were to give the preference: First, to graduates of technical schools; second, to the graduates of the academic departments; but to employ no boy who had not been out for more than two years. The cause for the discontent on the part of the young men and their little use to the employers is to be attributed largely to the sudden and radical change from years spent in absorbing and assimilating knowledge for their own benefit to their new occupation of giving out and using what they have for the benefit of others.

Of all the habits and principles which make for success in a young man, the most useful is the determination to do and to do right all of those things which come his way each day, whether they are agreeable or disagreeable. It is a mistaken notion that character of the kind needed for successful co-operation, such as that found in a well-organized manufacturing establishment, is developed by the elective idea of allowing each boy to choose for himself those things which he will do. All of the good features of the elective system can better be obtained by permitting each young man to choose in general the object or purpose for which he wishes to educate himself, and then leaving the entire course of studies to the one or more professors in the faculty who are especially fitted to plan a complete and logical course in the chosen field.

Dr. Taylor expressed the opinion that the greatest problem in university life is how to animate the students with an earnest, logical purpose. A class of young men who are almost universally imbued with such a purpose is found in those who, through necessity or otherwise, have come into close contact and direct competition with men working for a living. It would be an excellent plan for each student, say at the end of the Freshman year, to be handed over by the university for a period of six months to some commercial, engineering or manufacturing establishment, there to work as an employe at whatever job is given him, either manual or other work. There would be little difficulty in obtaining the co-operation of our business and manufacturing establishments in carrying out this plan.

Meeting of Western Association of Electrical Inspectors.

The second annual meeting of the Western Association of Electrical Inspectors was held in the Denison Hotel, in Indianapolis, October 17 to 19, inclusive. F. D. Varnam, of St. Paul, president of the association, presided. The first day was taken up with the discussion of various topics, routine business and the inspection of the wiring of the T. B. Laycock plant, in the east part of the city, and the enjoyment of the courtesy of the Laycock people at luncheon.

In his report, as president, Mr. Varnam noted the steady growth of the organization and said that although it had been in existence only sixteen months it had a membership of a hundred and thirty-seven. He spoke in a general way of the purposes of the organization, and asked the members present to make use of the opportunity to exchange ideas for the mutual good of all present. He referred to the work of the secretary of the organization, and commended Mr. Boyd for his efficiency. Mr. Varnam said that it was a pleasing coincidence that the National Association of Fire Underwriters was holding a convention in Indianapolis. The electric hazard is growing and he urged the importance of careful work in electrical inspection to the end that such hazard might be greatly reduced. Mr. Varnam suggested that the articles of association be so changed as to permit any one having changed his vocation to some other calling than that of electrical inspector, to be continued as an associate member.

The afternoon session was given up to the discussion of, and action on, the report of the committee on the National Electrical Code. The various suggestions in the report of the committee were of a technical nature, dealing with systems of installation and wiring. The suggestions that were acted upon favorably are to be submitted to the electrical committee representing some twelve or fifteen associations throughout the country interested directly in electrical matters.

The report of committee on grounding of conductors for safety aroused considerable discussion. During this discussion a number of water works people were present, being interested in the matter of electrolytic injury to water pipes.

The construction and installation of electric signs was discussed as was also show window and display lighting, and instruction to the public concerning the safe operation and maintenance of electric wiring and apparatus.

Mr. G. H. Sandorn, chairman of the National Electrical Code Committee, of the National Electrical Contractors' Association, read a paper on the subject of electrical inspection from the viewpoint of the contractor. This paper brought out the fact that there is considerable friction between these elements. Much valuable advice was given along lines calculated to lessen this trouble. A very interesting and instructive talk on the manufacture and test of rubber-covered wire, was made by Mr. Hugh Wreaks, secretary of the Wire Inspection Bureau of New York, after which the election of officers was held, resulting as follows: President, Waldemar Michaelson, Omaha; first vice-president, J. H. Montgomery, Detroit; second vice-president, George D Bayle, Chicago; secretary, W. S. Boyd, Chicago.

The convention was well attended, the interest manifested was good and the courtesy of the people was recognized in a vote of thanks.

One of the most enjoyable trips was that of the inspection of the electrical equipment of the Indianapolis & Cincinnati Traction Company line and power house at Rushville. The delegates were taken from Indianapolis to Rushville on a special car at high speed. At the power house considerable attention was given to an inspection of the electrical machinery and to the causes that led to the recent loss of life near the plant by reason of a wire fence becoming charged with electricity.

Municipal Ownership Defeat at Seattle.

An interesting account has just been made available of the successful campaign against the proposed municipal trolley scheme at Seattle, Wash. The plan submitted to the people was made up of three elements: (1) A proposed system of 20.17 miles of track, to be constructed as soon as possible, and to be paid for from an issue of $1,272,036 in bonds; (2) a trackage of 58 miles, to be constructed as soon as practicable, provided the initial system could be made to produce a revenue sufficient to induce investors to purchase bonds based on a percentage of gross earnings, involving an additional bond issue of $3,000,000; and (3) subway and elevated systems at a further cost of $3,307,904. Although the people were asked to authorize bond issues to the amount of $4,272,000, it was only proposed to build at once the 20.17 miles of trackage. Nevertheless elaborate maps, showing the proposed system, in its entirety, including elevated tracks and subways, the present building of which was in no way contemplated, were at once circulated by the advocates of municipal ownership. By such arguments it was sought to show how Seattle could acquire this great system "without costing the municipality a cent."

Many conditions favored the side of the opposition. Probably a greater portion of mechanics, artisans and workingmen of Seattle own their homes than in any other city in the United States. As a result of this the influence of labor organization is not as great there as elsewhere. Moreover, the city had numerous important and insistent needs straining her financial resources. Her debt already reached the constitutional limit. The valuations were about to be raised fully 50 per cent, thus providing a greatly augmented borrowing capacity, but even this would only furnish a fund barely sufficient for carrying out necessary improvements, including the enlargement of water supply, paving, sewer extension, and other improvements.

Another factor which favored the opposition was that half a dozen years ago Seattle was served by no less than thirteen separate street car lines, most of them operated by receivers. The Seattle Electric Company, the majority of stock in which was owned by Stone & Webster, consolidated these lines, put them under one central management, inaugurated a complete transfer system, renewed and improved the equipment and as a result, immeasurably improved the service. The population of Seattle is officially estimated at 176,000, and the trackage of the electric company amounts to 114 miles, or one mile for every 1,540 persons, a trackage far above the average to residents of American cities. The service is as nearly perfect as the rapid growth of the city will permit. It was not difficult, therefore, to show that Seattle might be a good deal worse off in its street car service than was actually the case.

But the opponents of municipal ownership had to combat a sentiment in its favor which had been fostered for many years. This sentiment had crystallized in the nomination for Mayor in January of this year of William Hichman Moore, a Democrat and a prominent lawyer. The platform on which he stood was devoted exclusively to the advocacy of municipal ownership and operation of the street railways of Seattle. The platform declared that no new franchises or renewals should be granted, except after submission to the direct vote of the people; that no further grants should be made to the company now operating in Seattle, except for minor connections and necessary extensions to residence districts, and that there should be submitted to the people at the earliest date practicable a plan for a system of municipal lines to be constructed from money raised on bonds, based on the credit of the system and its revenues. Mr. Moore was elected, so that when the referendum was presented the opponents of municipal ownership had to start with the initial verdict of the people already apparently against them.

Thus handicapped, the first step was to organize the opposition. This was done by the formation of the Seattle Economic League. J. M. Frink, a former mayor of Seattle, and a man of wealth and high standing, was elected president, with John H. McGraw, former Governor of the State of Washington, as right-hand man. The League decided on a campaign of education, and although it was late in the field it pressed its work with great vigor. It first issued an address to the voters, in which it clearly set forth the reasons of its opposition to the street railway proposition. Enclosed with the address was a postal card addressed to the League. This the recipient was asked to sign and return. About 20,000 of these were sent out and 1,500 favorable responses were received.

A statement of the financial condition of the city was prepared, showing the debt which it already carried, the debt which it would have to carry in order to have adequate water facilities, and the debt which was proposed to fix upon the city in addition, for an unnecessary experiment. The tremendous increase of Seattle's debt within three years was set forth by this debt statement, which was mailed to all the registered voters of the city. The League next secured the services of several competent speakers and these it furnished to local improvement clubs and other bodies considering the municipal ownership problem. A pamphlet was prepared, showing the improvements which the city's growth rendered imperative, and it was pointed out to the voter that because of the debt limit choice would have to be made between these and the municipal railway experiment. This was circulated in the districts most in need of more water and more sewers.

Conferences were held with the editors of a local newspaper to systematize the newspaper campaign. The Seattle *Times* entered heartily into all plans for a systematic campaign of education, and for two weeks preceding the election practically gave over its news and editorial columns to arguments furnished by the League or prepared by members of its own staff. The League also purchased space in the newspapers and began therein a series of "Daily Talks to Voters," which continued until election day. In these talks it was aimed to simplify the arguments and to present each day one good, conclusive reason for voting against the municipal street railway proposition.

Sets of cards, or "throw-aways," were devised—six in number—showing on the reverse a large square indicating the amount of territory to be mortgaged to produce the municipal street car system, and a much smaller square indicating the territory which would be served or possibly benefited by the proposed lines. On the face of the cards various suggestions, calculated to set the voter thinking, were printed.

In all the League circulated during the campaign over 250,000 pamphlets and cards, not including matter published in the newspapers. Every voter in Seattle received at least three separate communications; half the voters received four, and many received five. About 10,000 advisory ballots were prepared and distributed on election day.

The friends of municipal ownership were very active, but the Economic League continued to present its facts undaunted and relentlessly. It was a campaign of education pure and simple, no personalities entering into it. The result disclosed what can be accomplished by an appeal to reason and sober judgment. When the ballots were counted they showed 5,856 in favor of municipal street cars and 7,336 against. The opposition majority was thus 1,480. As a three-fifths vote was required to carry the scheme, it fell short of success by about 2,100 votes, an astonishing percentage, in view of the vote of only a few months before.

Edison Extensions in Boston.

The Boston Edison Company, as already noted, is making large extensions to its equipment for executive staff and the management force in general. There has been added one story to the old office building at 3 Head Place. The boiler house on Bumstead Court has been torn down and a six-story building, connecting with 3 Head Place, erected. These different floors are being plastered and finished and the fourth floor on the Bumstead Court side is being temporarily used. The boilers are set and the steam contractor is making his connections. The elevator men are also at work putting up their guides.

On Boylston Street the new building is a ten-story structure, with a finished basement. The exterior is of rather unusual construction, as it has only one large window or opening 22 ft. wide, divided into sections with bronze framework and glass. The material used is Indiana limestone. The cornice is finished in modeled copper, which is to be outlined with electric lamps, as

are also many of the other architectural features on the front. Extending above the roof is a tower 205 ft. above the level of the sea. On the top of this tower it is the intention of the company to have a revolving electric sign. All the above work is completed except the bronze window and the contractors are laying concrete on the floor arches, laying the floor plank, putting in the plumbing and laying the conduits for the electric wiring and the piping for the steam ventilating system.

Railway Association Officers.

At the meeting in Columbus last week the following officers of the American Street and Interurban Railway Association and its allied organizations were elected:

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION.

President, Mr. John I. Beggs, Milwaukee. Vice-presidents—Messrs. C. G. Goodrich, Minneapolis; James F. Shaw, Worcester, and Arthur W. Brady, Indianapolis. Prof. B. V. Swenson, 60 Wall Street, is secretary of the parent body.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION.

President, Mr. H. H. Adams, Baltimore. Vice-presidents—Messrs. F. G. Simmons, Milwaukee; J. S. Doyle, New York, and Paul Winsor, Boston. Secretary and treasurer, Mr. Walter Mower, London, Canada.

AMERICAN STREET AND INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION.

President, Mr. C. L. S. Tingley, Philadelphia. Vice-presidents—Messrs. J. H. Neal, Boston; E. F. Bryant, Bridgeport, Conn., and C. L. Wight, Des Moines, Iowa. Secretary and treasurer, Mr. Elmer M. White, Birmingham, Ala.

AMERICAN STREET AND INTERURBAN RAILWAY CLAIM AGENTS' ASSOCIATION.

President, Mr. S. L. Rhoades, Philadelphia. Vice-presidents—Messrs. Henry G. Bradley, Chicago; A. J. Farrell, Buffalo, and W. F. Weh, Cleveland. Secretary and treasurer, Mr. B. B. Davis, Columbus, Ohio.

AMERICAN STREET AND INTERURBAN RAILWAY MANUFACTURERS' ASSOCIATION.

The officers of this association are selected by the Executive Committee, which consists of Messrs. H. C. Evans, New York; C. C. Perce, Boston; A. Sisson, St. Louis; K. D. Hequembourg, Syracuse, N. Y.; W. M. McFarland, Pittsburg; Hugh N. Wilson, Chicago; John A. Brill, Philadelphia; Joseph L. Ellicott, New York; Charles K. King, Mansfield, Ohio; Charles Knickerbocker, Chicago; George J. Kobusch, St. Louis; Howard F. Martin, Philadelphia; Frank C. Randall, New York; Wm. Wharton, Jr., Philadelphia; E. M. Williams, Cleveland, Ohio.

A Poulsen Method of Tuning in Wireless Telegraphy.

A new method of wireless telegraphy in which it is claimed the sending and receiving apparatus can be accurately syntonized with each other has been recently put to practical tests by V. Poulsen, the inventor of the telegraphone. The apparatus is based on the singing arc phenomenon. While in the ordinary singing arc the current feeding the arc must be of low intensity, Poulsen uses electric arcs in a nitrogen atmosphere to produce strong alternating currents in a condenser connected up to the arc, which currents are transmitted to the signaling circuits. Copper and charcoal serve as electrodes, a nitrogen compound being drawn through the walls of the carbon into the arc, there to be vaporized. The impulse producing the oscillations is due to variations in the tension of the electric arc, which are reinforced by blowing the arc out to greater length with an electromagnet, thus increasing its resistance. Poulsen thus obtains strong continuous oscillations of constant amplitude by means of continuous current, whereas the oscillations used in ordinary wireless telegraphy have a high initial amplitude which gradually decays. Experiments so far made between two Danish stations are stated to give extremely satisfactory results.

A Report on Street Lighting at Utica, N. Y.

The special committee of the common council of Utica, N. Y., after visiting several cities in the State, has filed an interesting report as to prices of public lighting in such communities, and the general conditions prevailing. Some of the data is necessarily the same as that included in the recent report of the engineer of Rochester, N. Y. Aside from the statistical portion of the report, various passages deal with the situation as to competition and the subjoined may be quoted:

"In view of the application recently made to this council by parties interested in exploiting an electric power company in this and other territory in the vicinity of Utica, your committee has deemed it advisable to inquire somewhat into the net permanent benefits obtained in municipalities throughout the State by threatened competition of this kind on established companies occupying the respective localities. As a result of our inquiries we find that, during the last twenty years of the history of electric lighting in this State, there is scarcely a single city or town of any size in the State having a privately owned gas or electric plant whose business has not been jeopardized by companies formed for the purpose or by a combination of men seeking to get control at their own price. We find that in some cities and villages the local companies have had to meet this situation several times; no sooner would one war terminate in the failure of one of the companies, the sale by one to the other, or consolidation of the two, than a new aggregation of persistent franchise seekers appear on the scene, and this process, sale and consolidation of interest again gone through with, with varying results to the contending companies, but in no case, so far as we have been able to learn, have substantial permanent benefits resulted to the communities where these temporary rate wars have occurred. Perhaps nothing illustrates this better than the recent experience of the city of Rochester, and our neighboring city of Oneida. Before the adjournment of the last Legislature a company, known as the Eastern Monroe Electric Light & Gas Company, was authorized by special act to do business in the city of Rochester. So far as we have been able to learn, the company did not have a capacity to exceed 250 hp, and was engaged in furnishing a small amount of lighting at Dispatch, N. Y., a suburb of Rochester. The enterprising gentlemen back of the new company evidently appreciating that as a new five-year contract was to be let in the city of Rochester this fall, the time to strike was ripe. The cry of competition and lower rates was raised, and sufficient public sentiment created to pass the bill. For a time loud talk was heard of sharp competition, lower rates and the large investment to be made by the new company. Just previous to the letting of the Rochester contract in September, the Rochester Railway & Lighting Company bought out the new company. Evidently the city received no benefit from the raid. Further, the experience at Oneida is so recent that it is familiar to all. A ruinous price was bid for street lighting by a competing company, which was followed promptly and within the past ten days by the sale of the old company to the exploiters of the new."

The report discusses the act appointing the State Gas & Electric Commission and says: "This clearly demonstrates that the policy of the State has been changed, as it has been relative to the construction of new railroads, and that the question of rates was to be settled and determined, not by ruinous competition, but by State regulation, thus securing some permanency of investment and at the same time amply protecting the interests of the public and municipalities." It adds: "At a time when our Chamber of Commerce and many of our leading citizens are engaged on plans for the improvements of our parks and streets, and in other ways to add to the attractive features of our already beautiful city, we regard it as extremely unwise to grant any franchise which will result in duplicate lines of poles, wires and electric distributing systems which cannot but disfigure our streets, and as we believe, will not result in any permanent benefit to the city. We believe that all questions regarding the prices

to be charged by gas and electric lighting companies in this State can be safely let to the regulation, control and enforcement of the Commission of Gas and Electricity of the State of New York, which was created and exists for the sole purpose of such regulation."

The following remarks are of a more specific, technical nature as to methods of lighting, and merit quotation: "In the course of our inquiries into this whole subject of street lighting, we found that a strong opinion prevailed in many quarters that street lighting should be furnished to the communities practically at cost by the company occupying the local field. From such data as we have been able to examine, we are satisfied that the cost of operating an electric arc lamp in this State varies in different localities from $56 to $78 per year for an arc lamp of 2,000 nominal candle-power. In the several cities visited by us we failed to find anything in the systems there employed which can be considered in any way an improvement over the practice employed in Utica for the erection of poles, stringing of wires, distribution of lamps and generally illuminating the business and residential streets. In conclusion we would report against the adoption of the plan of hanging lamps in pairs in the business portion of the city after the method above described, for the reasons that the expense of this style of lighting is out of all proportion with its efficiency, and for the reason that we consider it unjust to multiply lamps in business sections for purely decorative purposes at the expense of rapidly growing outlying wards, where additional lamps are really needed for the proper illumination of the streets. We further report that if satisfactory arrangements, whereby the interests of the city are fully and amply protected, can be made with the company which is now lighting the streets, for a continuance of its service at what is deemed a reasonable price, we think it advisable and for the best interests of the city that such arrangements be perfected."

Central Station Practice in Europe.

At a meeting of the electrical section of the Western Society of Engineers at Chicago October 19 Mr. P. Junkersfeld, of the Chicago Edison Company, gave an interesting talk on some of his observations in connection with electric light and power work in Europe during a trip abroad the past summer. In London the central station situation is in a deplorable condition owing to the great number of small companies serving different districts of the city. As a consequence London does not enjoy the benefits of improved service and reduced rates that are made possible by consolidations in this country. Bills have been introduced into Parliament at two past sessions authorizing a large power company to build a large central plant to supply all these smaller companies and generate power for all customers desiring it. Both these bills have failed to pass so that there is no relief in sight. The largest of the London electric light and power companies has a maximum capacity of only 12,000 or 14,000 kw.

In Berlin he found practice much more up-to-date. The city is served by a few large power stations. The practice differs from that in this country, however, in that the whole system of power house and distribution lines is not tied together in parallel as would be done here. The distribution is sectionalized so that not even all the output of one power plant goes to the same feeder system.

Considerable has been said in this country about gas engine practice in Europe and the progress made with gas engines there. He did not find that European managers were taking much interest in gas engines. They talked of it as we do here as a matter for the future, but something not to be given much consideration at present. There is, however, great interest in the steam turbine.

Among other lantern slides he showed an interesting installation of high-tension oil switches in Berlin in which each switch is mounted on a truck so that it can be withdrawn for inspection and repairs from the row in which it is placed.

His observations on lamps and lamp renewals were that English practice is in a very bad way. Customers buy their own lamps from hardware stores and nearly all lamps are of four watts per candle. English lamps are, as a rule, nowhere near the quality of American lamps. In Berlin and Vienna the incandescent lamp situation was much better. Lamps of 3.1-watt consumption, as in America, were common. Many tantalum lamps were in use and the tungsten lamp was beginning to appear. One reason that special forms of arc lamps as well as other high-efficiency lamps have been so easily introduced in Germany is that the German shop keeper is a natural born mechanic and tinker. He prefers to trim and look after his own arc lamps rather than have anyone else mussing around his store to do it for him, and takes an interest in his lamps, which no American storekeeper would take. Large arc lamps for advertising purposes are common, arcs of 20 amp. being frequently seen. In Paris gas lighting seems to have things its own way, as but little electric light is seen.

German-Russian Wireless Telegraph.

According to a notice just published in the German daily press, the Wireless Telegraph Company, of Berlin, has succeeded in establishing communication between its huge station erected at Nauen and St. Petersburg, Russia. Experiments at the Nauen station consisted first in establishing wireless communication with a warship in Kiel harbor, after which a connection was obtained with the Norddeich wireless station and eventually with the station installed at Scheveningen, Holland. One morning a telegram to Norddeich received the following reply from Rigi Scheidegg, where a Swiss military wireless station has been established: "Wireless telegrams received very intensely; who has been sending?" Wireless replies confirming the receipt of wireless telegrams were also sent in from many other quarters and among others from the Darmstadt Technical High School.

Recently the experiments were extended on a larger scale, it being the intention in the first place to get a connection with the St. Petersburg wireless station which in a straight line is about 900 miles distant from Nauen. The Russian apparatus is designed on the Popow-Telefunken system, a combination of the German and Russian systems, differing only in some details from the German Telefunken system. Telegrams were sent to the Polkowopole station, near St. Petersburg, and an answer was received that the messages had arrived safely. These experiments are being continued, it being intended to communicate with the northern shore of Africa, where the Wireless Telegraph Company in the name of the Turkish postal authorities has installed a station at Derna, Tripolis, while another Turkish station has been erected in Patara (Asia Minor) opposite Rhodos Island. Both stations comprise wooden receiving towers 65 meters in height.

Electricity at the Boston Food Fair.

Electricity plays a useful part as an auxiliary in the success of the Boston Food Fair, an annual exhibition held in the Mechanics' Building of that city. Local and long-distance telephone service is now a regular feature of these exhibitions, and the electric sign of the flasher variety is used effectively to advertise the facilities offered. The safe and flexible illumination of the scores of booths displaying various food products is accomplished better by electricity than is possible in any other way, and it goes without saying that the decorations would be meagre indeed without the ornamental powers of the incandescent lamp.

The small motor is a factor of importance in the Food Fair, and whether it drives an automaton, a candy stirrer or a cider mill it is an almost indispensable device to the exhibitor who wishes to display moving mechanisms without increasing the fire risk or adding to the cost of his rented space on account of power requirements. A notable feature of the Boston show this year is a full sized electrically-driven cider mill in operation. The mill is shown by the Hydraulic Press Manufacturing Company, of Mt. Gilead, Ohio, and has a capacity of from 40 to 45 barrels per day. It is driven by a 5-hp motor and the driving mechanism also operates a 60-ton press by means of a pump and multiplied cylinder areas. The press and mill are mounted on the same structure. It was given out that a mill of this capacity costs about $318, exclusive of the motor.

A novelty in the form of a child's savings bank was shown by John Carey, of New York. The bank can be unlocked only by means of a permanent magnet, which draws the lock lever when inserted in the bank cover.

Scandinavian Engineers' Union.

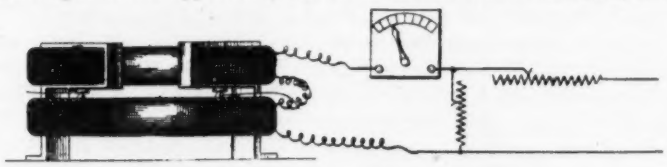
In June a meeting of Scandinavian engineers and students was held in Dresden to discuss the formation of a Society of Scandinavian Engineers, and it was decided to proceed with the movement at once. An organization has since been perfected and has been warmly welcomed by the Scandinavian press.

At first it was intended that the union should only comprise students and practicing engineers living abroad, but it has now been broadened to include all qualified Scandinavians, including Norwegians, Swedes, Danes and Finns. The fact that the union was organized outside the limits of Scandinavia is due to the large number of Scandinavian engineers studying abroad (197 Scandinavian engineering students matriculated in Germany alone last year) and also to questions of nationality, which will be avoided by the choice of neutral ground.

The union is conducted under the direction of a central committee, subordinate to which are local committees at technical schools and other centers in Scandinavia and foreign countries. Detailed information concerning the union may be obtained, until a New York committee is organized, from C. Von Frenckel, chairman of the Dresden committee, Technische Hochschule, Dresden, Germany.

Standard Current Meter.

A simple form of current measuring instrument designed for use as a secondary standard is described in a patent issued September 25 to Mr. Carl Hering. The instrument, which is illustrated herewith, consists of two coils placed one above the other; the upper coil is fixed and the lower is movable. The movable one is held up against the lower side of the fixed one by the attraction due to the currents in the two coils. The lower coil is so mounted that when the current which passes through the two coils in series exceeds a certain definite value this coil is held against the upper one, but when the current is less than this



HERING STANDARD CURRENT METER.

amount the lower coil at once drops away from the upper. The instrument is essentially one for indicating a single chosen value of current. To use the instrument the current in the circuit with it and the instrument to be calibrated is first made greater than the standard value, the movable coil being thereby held in its upper position. The current is then diminished very gradually until the movable coil drops. It is stated that the only correction required at any time, when the instrument is used as a secondary standard, is that for the variations of the force of gravity due to the difference of latitude and elevation. When extreme accuracy is desired these variations can be allowed for.

Trouble Caused by a Wireless Station.

The quarterly fire report, No. 3, of the electrical bureau of the National Board of Fire Underwriters, makes note as follows of a very interesting and, it would seem, unusual occurrence. We should be glad to learn from our readers if they know of any other such cases. The report says:

The sending station apparatus of a wireless telegraph system was supplied by a 3-kw, 2,080-115-volt pole transformer on a three-phase system. This transformer broke down because of high voltage reactions caused by the wireless apparatus, and was replaced twice by other 3-kw transformers in parallel, all of which failed. A 7½-kw transformer was finally installed and operated satisfactorily.

In transmitting signals the secondary voltage (115) was raised to about 20,000 volts, which was impressed on the aerial conductors on the mast. It was found that this equipment when in use produced several breakdowns in lighting and small motor circuits in the neighborhood supplied by other transformers of the same system.

In a doctor's office diagonally across the street from the wireless station were incandescent lamps and small motors supplied from a transformer whose secondary line paralleled the secondary leading to the wireless apparatus. The reactions in the system caused by the sending apparatus of the wireless station caused the Edison plug fuses in the service entrance box to be blown violently, and destroyed the windings of a small motor. It is reported that these breakdowns were accompanied by flashes of flame about the apparatus in the office. Removing the doctor's service line to a position where it no longer paralleled the wireless secondary circuit corrected the trouble in this office. The wireless company also improved the contact of their ground connection, but it does not clearly appear how much this had to do with preventing further troubles. One or two other installations in the neighborhood, a closely built up city block, were affected to less degree. A number of telephones were rendered useless during sending of wireless messages, the code signals being loudly heard in the receivers. This was remedied by the insertion of suitable capacities in the telephone service circuits.

Schenectady Branch of American Institute of Electrical Engineers.

The third meeting of the season of the Schenectady Branch, American Institute of Electrical Engineers, was held on Saturday evening, October 20. Dr. Rossiter W. Raymond was the speaker of the evening and presented an address on "Professional Ethics," a subject of great interest at present to all electrical engineers on account of President Wheeler's similar address at the Milwaukee convention of the Institute, and the present activity on the part of the Institute's special committee recently appointed to formulate a code applicable to the electrical profession.

Dr. Raymond was greeted by an enthusiastic audience of some seven hundred, and the value of his remarks amply justified the large attendance.

As president of the American Institute of Mining Engineers for several years, as the efficient secretary of that body for some twenty years, and as editor for years of the *Engineering and Mining Journal*, which he founded, Dr. Raymond is particularly well equipped to speak with authority on the subject he chose. He addressed his remarks to the young engineers and students, speaking for loyalty to one's employer and to one's self, with a fund of anecdote and wit that seemed inexhaustible, and kept the room in laughter between the serious portions of his talk. He gave much good advice and summed up with the following general rule of engineering ethics:

"Do not do what you cannot tell, or, if there be a good reason for not telling the details, do not do what you cannot tell without shame." The speakers were introduced by Chairman Rushmore, and among others were Dr. Geo. R. Lunn, of the First Reformed Church; Dr. W. R. Whitney, of the Research Laboratory, General Electric Company, and Professor Hoffman, of Union University.

The branch meetings were held in the auditorium of the Schenectady High School, and the officers of the branch are greatly gratified by the continual increase in the size of the audience. Although the admission was by ticket only at this meeting, the attendance was the largest in the history of the branch. An interesting feature of the meeting was the large number of men who came prepared to join the branch. The membership committee has succeeded in building up a branch membership which already is more than three times the number of regular members and associates of the national body residing in Schenectady. At the same time, however, the local membership of the parent organization has been greatly increased on account of the activity of Institute work at Schenectady. Weekly meetings are being held through the Winter. On Friday, October 5, the Branch was addressed by Mr. T. Commerford Martin, on "Technical Journalism," and on October 12 by Mr. E. C. Acheson on "Inventions and Discoveries."

Aspects of Technical Journalism.*

The growth of which Schenectady is in one great industry the distinguished expression carries with it the reason why the technical press has sprung into existence and has become a vital force. There was a time in the early days of the Institute when on looking over a list of its members I could claim to know every one of them—perhaps four or five hundred. To-day as I look over the list of 4,000 members—as I scan the Schenectady roster —there are scores and scores of names of men I never yet met. This is inevitable, perhaps it is best for them and for me. But given a growing art, an activity of creation in it, and an increasing number of men devoted to its prosecution, there seems absolutely no other satisfactory medium of intercourse for it except such a body as the Institute, or its technical and trade press.

It is hard to conceive how a man desirous of keeping abreast of invention, improvement, experience and discussion in his profession or industry can possibly do so if he does not read with at least moderate diligence his technical paper. Even the worst trade journal is better than none; and the best will leave a true hunger for knowledge sorely unsatisfied. The technical journalist is a specialist, he is cultivating a restricted territory, he is working with a microscope, all of which tells against largeness, broadness, liberality. Yet intensified cultivation has its merits, and many a patch of lilies in Bermuda, or vines in France, yields a far more valuable product than a sprawling wheat farm in Minnesota with its thin 15 bushels to the acre.

No technical man can find outside his special class journal the right intellectual food—tough, indigestible and badly cooked as most of it may be. The efforts of the daily press to be technical and supply valuable data, are laudable; the engineering supplement to the London *Times* is the best example of how far such a tendency can go; and the synopses given in many American journals of scientific and industrial news are praiseworthy from the standpoint of the average reader. But much of what gets into print thus is to be regarded with suspicion, though reflecting no discredit on the daily whose pages it brightens. Now and again there is a book in the nature of a revelation, but the majority of the text-books in our schools and on our shelves are years behind the latest things going. These facts the student, in college or out, must get from the technical press. Being often asked for the latest book on a subject I have been struck with the frequency, the invariability with which one's recommendation unavoidably carries with it a number of articles recently printed in the technical press.

When Mr. Carnegie a few years ago opened the library at Braddock, Pa., he warmly advised the careful reading of the trade press; and in his suggestive lecture on business at Cornell University in 1896 he remarked: "You see, gentlemen, the business man of this day has to read, yes, and study, and go to the root of many things, that he may avoid the pitfalls that surround business on every side." In other words, the technical journal is an essential tool of professional, industrial and commercial lfe. When I meet a young engineer and discover that he has, unless for some valid reason, failed to join the national or local society of his branch of engineering, I find myself involuntarily putting a black mark against his name. When I discover also that he does not read regularly the journals of the art, he becomes more hopelessly "conditioned" in my mind, as one without professional pride and dignity, and as one who on his own confession does not keep himself so informed about progress that he can be properly useful in the world.

I have been formulating a plea or reason for the existence of technical journals as the clearing houses of current knowledge, as a necessary tool, as a means of intercourse, without any implication that any one of them is all that might be expected of it. Every human institution is branded with imperfection, and it is only of late years that most technical journals have even begun to attack the tasks before them or discharge the responsibilities resting upon them. Aside from the conceded inadequacy of the editors and managers, nowhere more painfully realized than among themselves, two very great difficulties steadily prevent these luminaries from being of full candle-power. One of these is the inability to find men who have a story to tell and who can tell it well. The other is the reluctance of corporations and individuals to make public for common benefit the information acquired primarily for themselves in dealing with a subject, and often at enormous expense. Both these are evils and may be glanced at separately.

It may appear curious in these days when it is supposed everybody writes to complain that there is not writing enough. Lady Holland once said to Lord Porchester: "I am sorry to hear you are going to publish a poem. Can't you suppress it?" And when one wades through the countless popular magazines and the endless Sunday newspapers, and realizes how many beautiful miles of the forest fall daily under the axe to supply food for the ravenous presses of the age, it does seem as though the whispering trees would be better than so much loud talk. But as sinners against the Adirondacks the technical papers are venial offenders with their little editions, when compared with "yellows" boasting half a million copies daily, or "muckrakers" running a million a month. Those outlets for the productions of the intellect are always clogged with copy, but the technical journals in reality have little offered them voluntarily, and are frequently at a loss to get the right man to deal with a topic. For some inexplicable reason the phrase "an officer and a gentleman" does not find its equivalent in "an engineer and an author," although the engineer almost daily has an experience or an observation which if duly recorded would be of value and economy to every one else in the same field of work; and even if the single fact is of little utility a number of them might permit the generalization out of which great truths and great inventions would presently emerge.

If the technical journals could get more of these articles, they would pass in glad silence over the fact that the authors knew little of prosody or syntax, and have never used any but "simplified spelling." The great want of the time is, indeed, the ability to observe and then tell clearly and directly what is seen. This whole great electrical field of ours teems with obscure phenomena, with hints, suggestions, ideas, so that if a man notes something and does not know himself how to make use of it he can at least be useful by passing it on. There may be an improvement or a refinement in the art involved in the merest trifle; there may be the germ of a great invention. Chiefly thus does the improbable or the impossible become the prosaic and commonplace. "Numerous attempts have been made," said Herbert Spencer, in his treatise on "Education," "to construct electromagnetic engines, in the hope of superseding steam, but had those who supplied the money understood the general law of the correlation and the equivalent of forces, they might have had better balances at their banks." These very works are building yearly thousands of dynamo-electric machines that supersede steam in every branch of industry, but the process of their creation since Spencer wrote, down to the moment when No. 6000 went on the Central tracks, has been one of almost imperceptible gradations of advance; and each advance has involved one closer observation of the conditions and facts to be dealt with in solving the problem. Such data are the very pith and marrow of the technical journal, and while I yield to none in profound admiration of the creative inventor—the Edison, Thomson, Rice or Steinmetz—I become more and more convinced that in large measure the magnificent growth during the past century in the arts and sciences is due to the swift printing and circulating of new knowledge, which even to the genius is stimulating food for thought.

Perhaps there might be more encouragement for such writing if it paid better. True. In this respect the technical field, with its small editions, cannot compete with the daily papers or the popular magazine. I know something of the affairs of four technical journals, and in not one of them does the subscription price begin to pay for the mechanical cost of production, the paper, presswork, ink and binding. Obviously the margin for the intellectual cost cannot be very great; and it is not. I have never known a millionaire among trade press publishers; I have never known one who did not stick close to his job, working strenuously day in and day out to build up and conserve the business and the paper. The fact is, the contributor to a technical journal, like the author of a paper before the Institute, must not overlook what we may call the "earned increment"

* Extracts from an address before the Schenectady Branch of the American Institute of Electrical Engineers, October 5, 1906, by T. Commerford Martin.

that comes from publicity, enhanced reputation and the wonderful usufruct that flows in upon us every time we do a public service or a disinterested act.

That brings me to the other consideration I referred to in the matter of publicity. Roughly, possible writers for the technical press are grouped into men who couldn't and men who mustn't, leaving editors a very narrow range of collaboration. In other words, it is often to the interest of a great corporation to keep its mouth shut, and the casuistry of that situation has frequently caused me hours of perplexity. It all gets back to the old question of morals and sociology, how far a man has a right to that which is his own.

The fact that an important matter is not mentioned by the technical press does not imply ignorance of it. This year I published an article in regard to an important invention of which I had had knowledge for at least four years. During that time not one word had I printed about it. The list of the recipients for the Carnegie medal for heroism ought really to include people who, under temptation, hold their tongues. Sometimes things leak in a mysterious way, sometimes in a nefarious way, but it may be questioned whether the case is on record of a technical editor who took, or paid for knowingly, the story of an employe giving away the confidential secrets of the company he had been serving. It could not well be otherwise. It is not a question of fear of losing advertising patronage. That is curiously exaggerated in the public mind. I do not know a technical journal that could not lose the advertising patronage of half a dozen of its largest patrons without the slightest financial injury in the long run.

As noted already, each corporation has its publicity or literary bureau, which does deft, clever work of a high informational value. In the technical field this tendency results in the diffusion of a great deal of useful data of benefit to everybody in the art, whether going directly at first hand into the columns of the press, or given to that more select and critical audience constituted by such a body as the membership of the Institute. The only objection to the present prevalent plan of spreading the same article profusely broadcast is that it becomes mutilated or emasculated because self-respecting papers object to print the same "story" *verb et lit,* just as though it were a mere electrotype. The other plan of inviting the editors to inspect a new appliance, and then give their own version, is better, even if they get it a bit wrong. One popular plan which has many obvious demerits is the modern house organ, where a corporation can say what it wants as it likes, and vaunt itself to the skies as to any new plant or product. Everybody discounts that kind of publicity immediately, and it carries no weight, even as compared with the issuance of exactly the same matter in a venal journal that makes a living by printing "write-ups." It is exactly the same kind of discount that an electrical journal is involuntarily subjected to by a general reader who peruses its advocacy of something electrical as preferable to something that is not. In the final analysis what we are all seeking is the truth published without bent or bias, without fear or favor.

Finally, a brief note on the journalist himself, the composite, mystical, elusive "we." More and more the "we" becomes a reality, however such a strong personality will assert itself and breathe in palpable form through the cold type, or exhibit itself in that exquisite thing called style. Without parading all the secrets of the prison house, I can say that in the paper with which I come in nearest touch, an editorial expression of opinion is very rarely that of one man. It is more often a blend, like good whiskey. One hand will contribute the fundamentals, others will furnish the harmonics and overtones, and when the editor who has least to do with it is complimented on his last admirable production, he will acquiesce in silent pride and complacency.

New York Electrical Society.

The next meeting of the New York Electrical Society will be held October 31 at the Edison Auditorium, 44 West Twenty-seventh Street, New York. Prof. V. Karapetoff, of Cornell University, will lecture on "The Human Side of the Engineering Profession," and an evening of unusual interest is expected.

CURRENT NEWS AND NOTES.

HORSE AND CABLE.—The last horse street railways in New York are being converted to electricity and on October 21 cable cars ceased to operate in Chicago, the last lingerers being replaced by the ubiquitous all-conquering trolley.

FISHING BY ELECTRICITY.—An interesting innovation is being made at Pinners Point, and Lamberts Point, Va., by which electric lamps are used by fishermen in catching large quantities of trout and other fish by night. The experiment is said to have been a boon to the fishermen. This scheme has been tried before, but the tests do not seem to be sustained. Possibly the reason is that the fish find the electric light too expensive.

COPPER IN GREENLAND.—New supplies of copper are opening up rapidly, and will be warmly welcomed by electrical interests. The Stockholm correspondent of the London *Tribune* says that the last expedition dispatched by M. Bernburg, a Copenhagen merchant, to make mineralogical researches in Greenland, has just returned. It reports the discovery of vast deposits of copper ore at Alanjarssnak, which, it is believed, may prove the richest and best in the world.

TROLLEY FARES IN DETROIT.—President Hutchins, of the Detroit United Railway, which controls the local street railways, has announced that early this week the company will put into effect for long enough to give all voters an opportunity to judge of them the rates of fare provided in the new franchise which the company seeks and which the voters will pass on at the November elections. The rates of fare are ten tickets for 25 cents during five hours of the day when workingmen ride, and six tickets for 25 cents the other nineteen hours. The present fares are 5 cents each on all but a few of the old Detroit Railway lines, on which eight tickets are sold for 25 cents.

MOTOR WAGON TESTS will begin in New York City on November 7 under the auspices of the Automobile Club of America. The rules and conditions, with maps of the two courses selected, have just been issued to manufacturers and others interested in the practical results of the contest. The entries must be filed by November 1 and a fee of $25 is exacted for each car. The contest is open to all machines, whether propelled by electricity, steam or gasoline. Each car must carry a dead load weight of at least 50 per cent of its own weight, with all supplies on board in addition to the driver and official observer, the latter being appointed by the club.

GREAT AUTOMOBILE SHOW.—What will probably be the greatest and most comprehensive exhibition of motor cars ever held in this country will take place at the Grand Central Palace, Lexington Avenue and Forty-third Street, December 1 to 8, 1906, when the Automobile Club of America will hold its seventh annual show. While in previous years the club has generally held its exhibitions in Madison Square Garden, last year the show was held in the Sixty-ninth Regiment Armory, drawing enormous crowds, and this year the club has moved still further up town to a more central location in the Grand Central Palace, and advanced the date of its exhibition from January to December. That the earlier date and changed location has met with the approval of the manufacturers and the public, is shown by the fact that there are no fewer than 266 applications for space in this year's show. While more than 55,000 sq. ft. of show space was available in the exhibition hall and galleries at the Palace, considerable more room than was to be had in the Garden, there were applications for over 66,000 sq. ft. of space, and large as the building is it was found impossible to meet the exhibitors' demand for room. As a result the show committee of the club had to refuse the applications of thirty-six exhibitors, and cut down the space applied for by something like 11,000 sq. ft. In spite of the reduction there will be 230 exhibitors in this year's record-breaking show, including 94 manufacturers of motor cars and 136 exhibitors of accessories. The motor car exhibits will include the 38 manufacturers who comprise the American Motor Car Manufacturers' Association, 18 foreign cars and 48 other American manufacturers.

A MUNICIPAL SYMPOSIUM.—A symposium on municipal ownership, pro and con, has begun in the October issue of *Moody's Magazine* and will continue in November. The contributors this month are Mayor Dunne, of Chicago; F. C. Howe, Henry Clews, W. W. Freeman, ex-Gov. Garvin, of Rhode Island; T. C. Martin, G. V. S. Michaelis, E. W. Burdett, Hon. John Ford, C. Tomkins, H. T. Newcomb, L. F. Post, Prof. H. R. Meyer and W. L. Garrison. At a time when the subject so occupies public attention the series is pertinent and valuable.

ELECTRIC IRONS IN PUEBLO.—Between May 1 and October 1, 1906, Mr. C. M. Wright, contract agent of the Pueblo & Suburban Traction & Lighting Company, of Pueblo, Col., reports that his company installed 483 electric irons. Of these 294 were sold and 189 were loaned, the minimum bill of the customer being increased 50 cents per month as a guarantee of use of the iron. The irons range from 5, 6 and 7 lb. domestic sizes, to 18 and 20-lb. tailor irons. This, however, does not include all electric irons in use, as electrical supply dealers have also sold and installed irons.

ANOTHER RAY VICTIM.—Advices from London last week state that Mr. Hall Edwards, of Birmingham, the Röntgen ray expert, who has become a victim to chronic X-ray dermatitis, declares that he considers his case hopeless. All that he expects is some slight relief from his suffering, and he has appealed through the columns of the *British Medical Journal* for advice from medical men concerning the treatment of his disease. He also declares that he expects to lose all his fingers and possibly both his hands before long, but until that happens he will continue his work. His surgical practice has been entirely ruined by his disease and he is wholly dependent on his work as a radiographist.

ILLUMINATION IN BOSTON.—The Boston Edison Company had its monthly dinner and meeting on Friday evening, October 12, at which the guest and speaker of the evening was Mr. Van Rensselaer Lansingh. Mr. Lansingh gave an informal talk on the general principles of illumination with particular examples of different classes of lighting for houses, etc. Lantern slides were shown illustrating both good and bad features of the lighting of bedrooms, parlors, libraries, kitchens, etc. This was followed by a discussion of the merits and disadvantages of the latest forms of lamps, such as the tungsten, tantalum, etc., and the necessity of using these lamps in the best possible ways, especially with the proper and correct reflectors especially designed for them. The lecture wound up with a discussion and criticism of the existing lighting of the desks and with the offer of Mr. Hale, the general agent of the company, to authorize the funds to modernize the present installation.

WIRELESS NOT WIRELESS.—A cable dispatch from Berlin of October 20 says: "The municipality of Berlin to-night gave a banquet in honor of the delegates to the International Wireless Telegraph Conference. Mayor Kirschner presided and toasted the delegates, saying that the civilized world was watching the proceedings of the conference with the keenest interest and hoped that its results would benefit all mankind. Herr von Wehrenalp, the principal Austrian delegate, responded in behalf of the members of the conference, thanking Germany for taking the initiative for the international regulation of wireless telegraphy. General opinion is that the work of the conference is progressing satisfactorily, and that there is good prospect for an agreement, though, as Herr Von Kraetke, secretary of the Imperial German Post Office, remarked to a delegate, clause 3 of the convention, which comes up next week, will be the hard bone of contention." Clause 3 has not yet been handed out for general consumption or discussion.

ELECTRIC COPPER MINING.—It is stated from Houghton, Mich., that the work of electrifying the surface plants of the Calumet and Hecla copper mines which was begun about two years ago, has progressed to a point where results are becoming pleasingly evident. The new electric plant is located at Lake Linden, near the mills and smelters and four miles from the mine, which is on the hill above, effecting a considerable saving in transportation charges on fuel, as the company burns about a thousand short tons of soft coal daily. The new central plant is to replace a half dozen or more isolated plants, all of comparatively small size, and will greatly reduce the cost of motive power in many departments of mining and milling. The giant hoists and air compressors, of 2,000 to 8,000 hp each, for which this mine has been famous for many years, will use steam, as before, but the hundreds of small power equipments will employ electricity hereafter and it will be possible to equip the various lathes and other machines with individual motors, in accordance with the most advanced shop practice.

IMPROVEMENTS IN STEAM.—Advices from Pittsburg state that the Westinghouse Machine Company has acquired from the Société Anonyme Westinghouse of France the right to manufacture new types of condensing apparatus for use in connection with steam engines of all kinds under the patents of Maurice Leblanc, the French electrical engineer and inventor, who has been carrying on experiments at the Havre works of the Westinghouse Company during the past three years. These experiments have been watched by foreign steam engine manufacturers, and already many applications have been made to the French company for licenses under Mr. Leblanc's patents, such manufacturers being willing to pay high royalty for the privilege, since it has been shown that a vacuum can be obtained within two or three per cent of the theoretical limits. These new condensers should have immediate large application in connection with steam turbines. The Westinghouse Machine Company will begin at once to manufacture the various sizes required and will also manufacture a low-pressure turbine, i. e., a turbine which can be operated by exhaust steam. An important outcome of Mr. Leblanc's experimental work on condenser apparatus has been the development of a new refrigerating system—that is to say, Mr. Leblanc has found that by the use of his condensing apparatus in combination with the scientific application of steam, he can produce cold brine and ice without the use of ammonia or any objectionable gas, and without requiring any pressure above that of the atmosphere, with great economy in cost of apparatus and space required for its installation, as well as at lower cost of operation and thus a lower cost for refrigeration.

MUNICIPALISM IN ENGLAND.—A suggestive article is contributed to the October 19th *North American Review* by Ernest E. Williams, an eminent English writer on economics, entitled "How London Loses by Municipal Ownership." The results of London's experiments with municipal ownership, according to Mr. Williams, have been far different from what they were expected to be. The policies of the London County Council have been extremely expensive. Salaries, office expenses, pensions and so on, which cost £40,000 a year under the old régimé, cost in the year ended March last nearly £285,000. Expenses for inquiries and other activities of the various committees amounted last year to £109,000, whereas they used to cost London less than £5,000 a year. The increase in the expenditure of the British capital in other directions has been on a corresponding scale, and has greatly exceeded in proportion the increase of the population. "One more case of municipal ownership in London may be cited as a concluding illustration. The Council has recently taken up the manufacture of bricks. A gentleman who is himself one of the progressive members of the Council has described the Council's brick field as an unfortunate experiment, and has declared that, in the majority of cases, the bricks are unfit for use in the building of houses. The clay is difficult, the situation of the brick field very wet, and therefore bad for the bricks. Yet the Council, which is rightly the enemy of the 'jerry builder,' has sold these bricks for the erection of cottages. The mania of the Council for undertaking trading enterprises is insatiable; it grows by what it feeds on. And it is all part of the Collectivist policy inaugurated with the triumph of Municipal Socialism thirteen years ago. The Council aims at being the universal employer, intrudes into every possible domain of industry, crushes out private enterprise and relentlessly pursues it to destruction, wherever it can. Meanwhile an enormous and increasing debt is being laid upon London, the opportunities of private enterprise are curtailed, and the local taxes go up and up every year in order to pay for the municipalizers' costly fads."

CORRECTION.—In the article describing the Newton-Boston Edison sub-station in our issue for September 29, it was erroneously stated in the last line by the writer that the station was in operating charge of Mr. H. J. Fox. The station is in charge of Mr. Albert Yanda.

ELECTRIC COAL MINING MACHINES.—According to the annual report of the Pennsylvania Department of Mines, of 4,240 coal mining machines used in mines in that State, 1,250 are operated by electricity. Coal mining machines are used in 449 mines. The production of coal mined by machines was 50,461,000 tons last year, as against 68,900,000 tons by pick mining.

NEW PRESIDENT OF MASSACHUSETTS TECH.—It is reported from Boston that the executive committee of the Massachusetts Institute of Technology has invited Dr. Andrew Fleming West, of Princeton, to accept the presidency of the institute as the successor of Dr. Pritchett. Dr. West has been professor of Latin at Princeton since 1883, and since 1901 has been dean of the graduate school there.

INSULATING CEMENT.—A patent granted October 16 to J. A. Yates describes the manufacture of an insulating cement, which is stated to be particularly adaptable for use as the base of the incandescent lamp bulb. The cement consists of 32 per cent of white resin, 20 per cent of zinc oxide and 48 per cent of marble flour. It is stated that this cement, aside from insulating electric wires from each other, will withstand an application of heat up to the point ordinarily met in incandescent lamp bases. The claims of the patent cover the use of the above three ingredients and also the process of making the cement.

POWER CANAL ACCIDENT.—Owing to the breaking away of the bank of the canal leading from the New Milford Power Company's dam at Merwinsville to the power house at Bull's Bridge, the plant went out of service last Sunday, and New Britain and Waterbury, Conn., were put into darkness, while the trolleys in the vicinity were tied up. Conditions throughout the region thus deprived of electrical energy were serious for two or three days, as the general dependence on it has been carried to an unusual degree. It appears that the raceway bank was built of earth, without masonry and a leak in it had been overlooked, so that about 100 ft. went out and the water emptied itself into the Housatonic River, leaving the turbines dry. Not long since the plant was suffering from drought.

THANKING A CORPORATION.—The Board of Public Service, of Cincinnati, has given Mr. Norman G. Kenan and the Union Gas & Electric Company, of which he is president, a formal vote of thanks for an act of public-spiritedness seldom credited to a public service corporation. Numerous complaints some time ago satisfied City Electrician Jones and the members of the Board of Public Service that the lighting schedule was not satisfactory. At the same time it was admitted that any lengthening of the hours could be charged for by the gas and electric company, amounting to about $8,000 a year, or $50,000 for the time the contract has yet to run. Mr. Kenan at that time told Mr. Jones he would use his good offices to have the gas company grant the increase in hours without any increase to the city. He was successful, and the vote of the board was in appreciation of the generosity of Mr. Kenan and the company.

TESTING CONSUMERS' METERS.—The Electrical Engineering Department of Columbia University has secured the services of Ernest S. Holcombe, B.S., 1901 Cornell, to take charge of its instrument and standardization laboratory with the title of lecturer; Mr. S. S. Watkins, E.E., Columbia 1906, as assistant in the direct-current laboratory, and Mr. C. Otto von Dannenberg, bachelor of engineering, Union College 1906, as assistant in the alternating-current laboratory. The department is now the official testing laboratory for electric meters for the city of New York. Complaints from consumers made to the Department of Water Supply, Gas and Electricity are sent to Columbia University when a test officer immediately makes a test of the complainant's meter and reports to the city department. Thus the consumer is assured of prompt and reliable results.

A RIVALRY WITH TESLA.—The St. Paul *Press* states that Mr. J. A. Stranahan, son of a farmer near Miller, S. D., is getting electrical energy from the air. He is said to be a graduate of an Eastern polytechnic institute. This is what is said: "Near his father's ranch are the Sully Buttes, towering several hundred feet above the surrounding country. On top of the highest of these Stranahan sent up a pair of tandem box kites, allowing them to rise to a height of several thousand feet. Between the tandem kites was strung an invention Stranahan has perfected for collecting and storing the Hertzian waves. Each of the tandem kites carries up with it a small wire cord, attached at either end to the collector and storer of electricity. Stranahan says that his scheme was successful from the start, so far as the production of an electrical current was concerned, but that the difficulty was in producing a current of sufficient potentiality to be of utility in farm work. After months of study and experimentation, however, he says that he hit upon a simple device which answered the requirements, and that now he is able to secure from the clouds a current sufficiently strong to run a 20-hp motor. He says that by increasing the size of his collector he is confident that he will be able to produce currents of practically unlimited power."

STEEL TROLLEY TIES.—According to a paper read last week before the American Street and Interurban Railway Engineering Association, by Mr. C. H. Clark, engineer of maintenance of way of the Cleveland Electric Railway, stated that steel ties have been used with marked success on some of the Cleveland lines carrying the heaviest traffic. The first were made by the Lorain Steel Company, and were laid 10 ft. apart, alternating with wooden ties. The concrete was 8 in. thick under the steel ties and 4 in. under the wooden ties, and was carried down under each rail so as to form a beam 10 in. deep. Satisfaction has also attended the use during the last two years of steel ties of a trough section made by Seitz Bros., of Tiffin, and laid like the Lorain tie. Of all steel ties that made by the Carnegie Steel Company is most acceptible to Mr. Clark. It is an I-beam section with a 4½-in. top flange, 8-in. bottom flange and a depth of 5½ in. The ties are spaced 6 ft. apart and the concrete is tamped 4 in. under the tie and 10 in. under the rail. Tie rods are placed over each tie. This track costs $41.66 for ties and $85 for concrete per 100 linear feet. Only the best 1:3:6 concrete should be used, for experience shows that poor concrete will result in early renewals. Special care must be taken in cross-bonding when steel ties are used, because corrosion is likely to occur where the current passes from the rails to the ties and tie rods.

ELECTRICAL FIRES reported in the October bulletin for the quarter by the National Board of Fire Underwriters summarizes as follows: Eight fires have been reported as caused by high-tension lines falling across lighting and telephone circuits. Losses so far as given, $1,850. Grounding of lighting and motor circuits has been responsible for nine fires. Losses as reported, $1,030. Short-circuits on interior wiring caused thirty-one fires. Principal loss reported was one of $9,800, due to short-circuit on flexible cord. Lightning, four fires; principal loss, $138,000. Moving picture machines, three fires; losses, $200. Electric motors, three fires. Electric flatirons, three fires; losses, $1,570. Fuses blowing caused eight fires, entailing total losses of $4,675. Rheostats, five fires; reported, one loss, $118. One tree fire reported. Fifteen accidents to persons were reported, of which seven resulted fatally, being mostly linemen coming in contact with trolley and high-tension wires. Total fire losses reported by inspectors, $160,588. Seventeen other fires were at first reported as due to electricity, but upon further reliable investigation by inspectors have been found due to other causes. The losses on these fires amounted to $96,100. All of the fires summarized above were reported to the bureau by inspectors. In addition forty accounts of supposed electrical fires were received in which the causes were given as "crossed wires," "defective wiring," etc. Of these fires no more definite information has been obtainable. The aggregate losses on these fires was $309,857.

SHORTER HOURS OF WORK.—An announcement has been issued by the General Electric Company in Lynn that the working time of its 9,000 employees will be reduced from fifty-six to fifty-five hours per week. In the future the employees will go to work at seven o'clock instead of 6:45 in the morning.

A NEW TURBINE.—Advices from Pittsburg state that the Westinghouse Machine Company announces that it has perfected a new type of steam turbine which is said to contain many improvements, especially advantageous where high power is required. No detailed description of the new turbine has yet been issued.

ENGINEERING IN SCOTLAND.—At Edinburgh, Scotland, on October 16, Mr. Andrew Carnegie opened the new engineering and natural philosophy departments of Edinburgh University, which were erected largely owing to his donations, Hon. A. J. Balfour, Chancellor of the university, in thanking Mr. Carnegie, Lord Elgin, and other contributors to the funds, conferred the degree of Doctor of Laws on Mr. Carnegie and Lord Elgin.

MARYLEBONE MULCTED.—A cable dispatch from London of October 11 is as follows: The Marylebone Borough Council was fined £60 under its own electric lighting ordinance. It appears that the municipality, after acquiring its lighting powers through a bad bargain, is unable to administer them within the terms of the law. The *Pall Mall Gazette* says: "Municipal trading has always shown a list in the direction of bankruptcy, but it is the crowning touch when it cannot escape the jurisdiction of a police magistrate."

BLOCK SIGNALS.—The New York State Board of Railroad Commissioners has called the attention of all steam railroads to the necessity of operating trains under some form of block signal system that will prevent more than one train being in a block at the same time, and therefore prevent collisions. This can be done, it says, by the manual controlled system, the automatic electrical block system, or the telegraph block system. If, owing to the volume of traffic, the telegraph stations as they are now located are too far apart to properly handle the business by the telegraph block system, intermediate blocks can be established. In the automatic electrical block system the blocks can be established of any desired length. The same is true of the manual controlled system.

GROWTH AT DAYTON, OHIO.—The Dayton Lighting Company has been making an unprecedented gain in business during the past few months by reason of extensive improvements in the system and energetic methods of soliciting business. During the month of September alone the equivalent of over 10,000 16-cp lamps was contracted for. This does not include 2,000 Nernst lamps ordered by merchants in the downtown section of the city. The contracting department of the company, which has been largely instrumental in this increase, was organized July 1 under the direction of J. E. Barrett, formerly of the Chicago Edison Company. Since March 1 over 1,000 new contracts have been secured by the department. During the first week in September 121 contracts were signed, which is the record-breaking week in the history of the company. Included in the department are specialists on power, illumination, signs and heating and cooking appliances. The business is increasing so rapidly that it will be necessary to add an extra force. The September business of 302 contracts was one-half larger than was secured in twenty years by the old lighting company which the present company succeeded.

ON CONGRESSES.—The New York *Evening Post* has these remarks anent congresses: "That there are too many scientific congresses is the complaint of a writer in the *Revue Scientifique.* While isolation is a bad thing for the man of science, and while it is essential to his usefulness and reputation that he should at times compare notes with his colleagues, much time, labor and money is wasted by the multiplicity of these assemblies. A concrete example of the incidental abuses is furnished by the same periodical, in its report of the Medical Congress at Lisbon. One of the chief evils was the diversity of language, although the use of Portuguese was not permitted in the discussions. The reports were distributed so tardily that members of the congress had no time in which to prepare themselves to speak. There were too many reports relating to the same subject, which gave rise to tiresome repetitions. Much time was lost in attending fêtes and other entertainments. Moreover, a number of eminent men failed to appear personally, and their papers were read for them by others. Yet the desire of attending congresses is keen, and it would be cruel to deprive the speakers of opportunities to be heard, or to prevent their hearers from manifesting the Christian graces of patience and long suffering."

ONE MORE NAPOLEON in the inventive field comes to the front in Napoleon R. Thibert, of Worcester, Mass., hitherto maker of spittoons, but now tamer of the universe. He says he is a graduate of Ann Arbor, which some day may be proud of him. Just now he needs a small sum of money to help carry out his ideas. "If I get my $15,000," said he, "there won't be any further need of electric cars, for electricity will become antiquated and unprofitable. I am going to produce a motive power that has electricity beaten 40 city blocks. If only someone comes forward with that $15,000 I'll also be able to make that Marconi system look amateurish, for I am going to penetrate the atmosphere for sound waves with so much greater keenness that really I feel bad for Marconi. Don't dare to tell me that there is one iota of a chance of a slip-up or mistake. I'm dead certain of what I'm about. All I need is the money, and that's coming right along. I am getting some of it in small installments, now. Did you ever hear tell of that Edison star that is sent up every night to take its place with other stars? No. Well, that's a luminous body elevated by the Edison people, through T. A. Edison, inventor, to a place in the skies, and looks just like all other stars and can be seen all over that part of the earth where the other stars are shining. It is sent up from an astronomical station at Albany. Well, when I get that $15,000 I can put that star out of business. It will be just like blowing out a candle. I can do it not only from Worcester but from any other spot on the face of the earth where the star is shining. If I want to," he continued, with a chuckle, "I cannot only douse the glim, but I can put the whole darn thing, star and all, out of existence."

THE TROLLEY REPAIRSHOP.—As is pointed out by the *Iron Age,* the electric railway is become an important factor in the machine tool field and market, and it shows how this work had led to the creation of a number of repair shops. It adds: "Yet street railroad practice has not yet reached a point which demands the best possible repair shop facilities. Too many makeshifts exist. There are some exceptions, where everything in a shop is just as it should be, the equipment being selected with as much discrimination as in a modern manufacturing establishment. But as a rule the street railroad management needs some enlightening as to shop needs. A few machine tool manufacturers and dealers are awake to this condition and are specializing in a way on this class of trade. One large company has issued a special catalogue for the street railroad trade. Special machinery is not required to any extent beyond special features of the repair shop of the steam road. But certain machines meet the special requirements of the class of work which the street railroad has to do, and it is good business on the part of the machine tool man to devote attention to these features and to bring them to the attention of this branch of the trade. Certain tools are indispensable for a good repair shop. There should be a car wheel lathe, or grinder, and an axle lathe. Engine lathes are of course required, as well as a milling machine, planer, drills, grinders, bolt cutters and forges. The lists may be advantageously increased by a punching and shearing machine, power hammer, pipe cutting-off and threading machine, power hack saw, boring mill, radial drill, turret lathe and shaper. The woodworking shop should be as well equipped. Cranes are desirable, especially for lifting car bodies from their trucks. The total cost of a complete plant is large, but if equipment is commensurate with the amount of work to be done the resultant saving pays a large percentage on the investment."

Sub-Stations and Transmission System of the New York Central & Hudson River Railroad.

IN the September 29 issue of the ELECTRICAL WORLD was published an account of the Port Morris power station of the New York Central & Hudson River Railroad. The current generated at this station is transmitted as three-phase, 25-cycle, 11,000-volt alternating current to sub-stations located as follows: No. 1 at the Grand Central terminal; No. 2 at Mott Haven junction; No. 3 at Kingsbridge, and No. 7 at Bronx Park. These four sub-stations are in the initial electric zone to be operated shortly but there are eight sub-stations in the entire electric zone. The other sub-stations are located as follows: No. 4 just north of the power station at Yonkers; No. 5 at Irvington; No. 6 at Ossining, and No. 8 at Scarsdale. Power is transmitted by overhead cable lines north of High Bridge on the Hudson division and north of Bronx Park on the Harlem division. Conduit lines run from the Grand Central Station to High Bridge and to Bronx Park as well as to the Port Morris power station and to Kingsbridge from the Harlem division line. From the Kingsbridge terminus of these conduits an overhead line runs to the Glenwood power station and sub-station. Cable towers for the overhead lines are located at High Bridge, Kingsbridge and Glenwood. In the initial electric zone, including on the Hudson division the line as far as Kingsbridge, there are 17 miles of line to be electrified—13 miles from the Grand Central station to Wakefield on the Harlem division and 4 miles from Mott Haven to Kingsbridge on the Hudson division. In this territory there

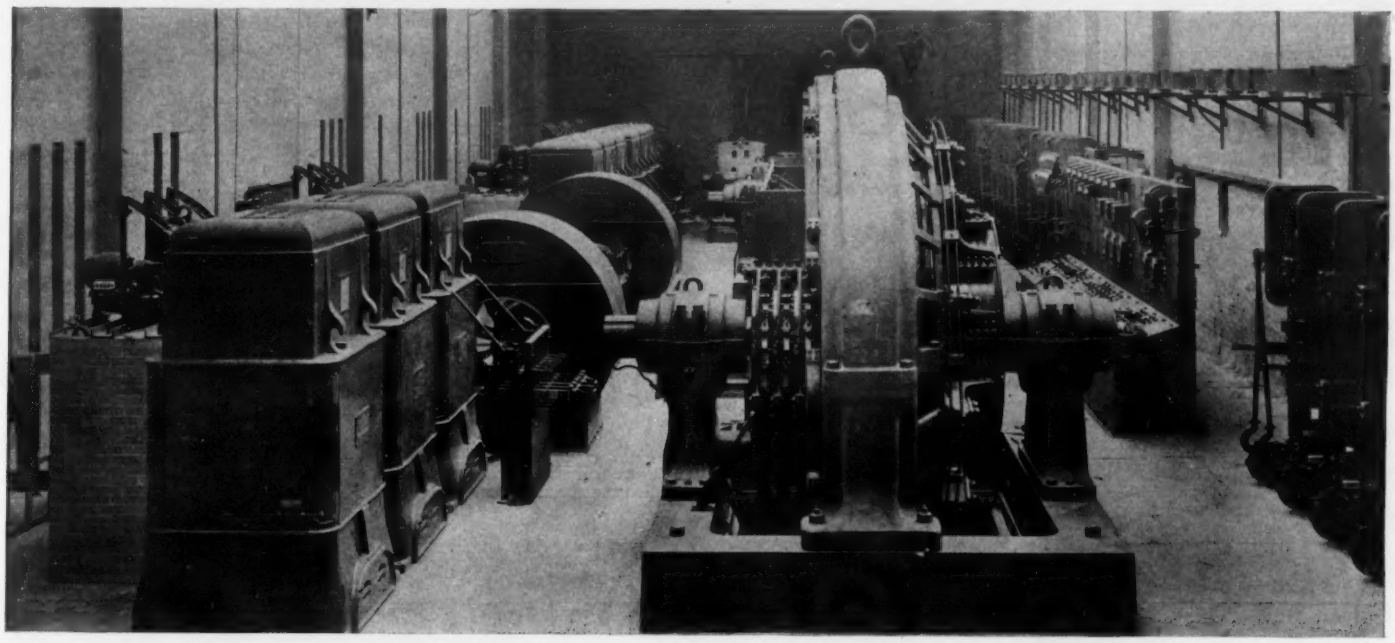


FIG. 1.—INTERIOR VIEW OF GRAND CENTRAL SUB-STATION.

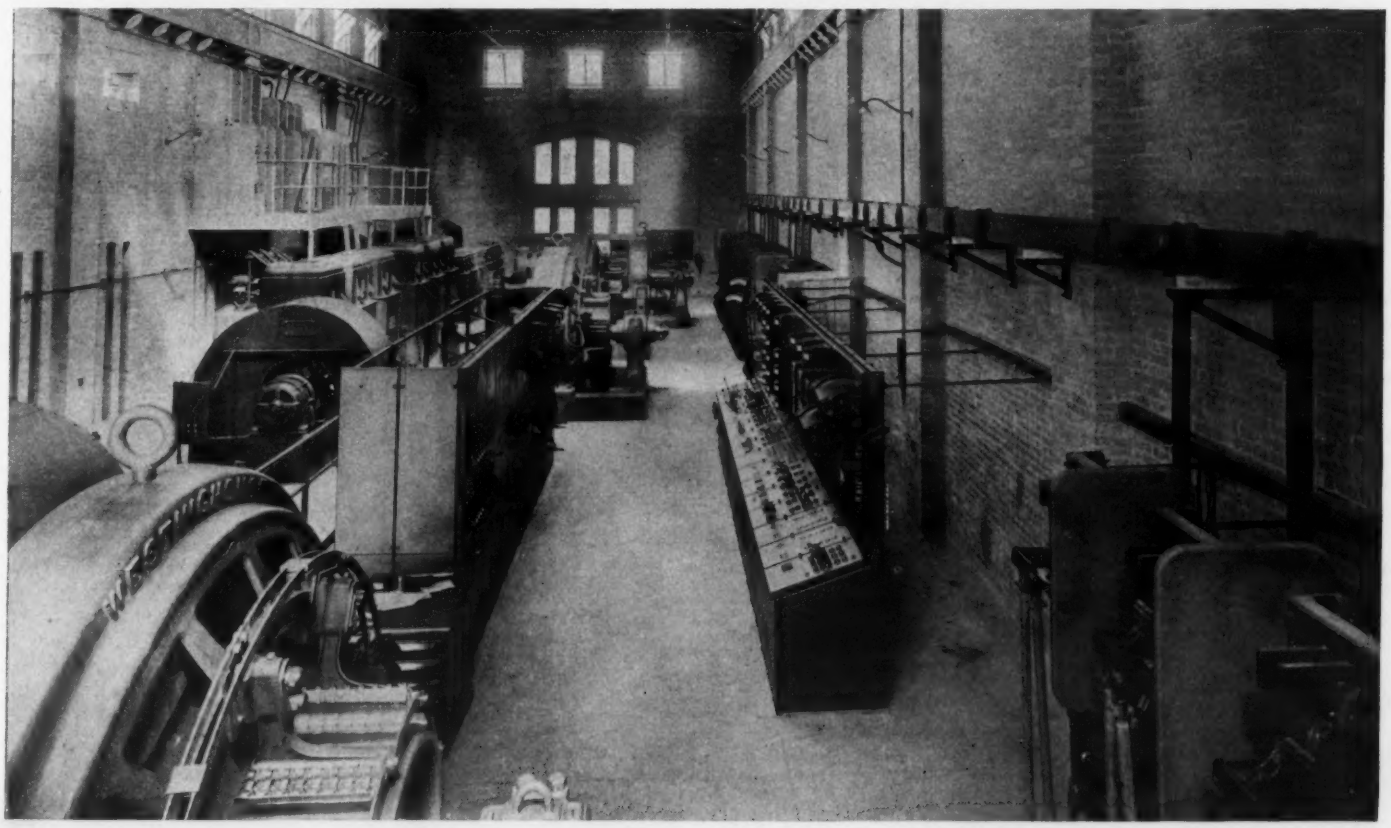


FIG. 2.—INTERIOR VIEW OF THE KINGSBRIDGE SUB-STATION.

are 73 miles of main and 12 miles of yard tracks, a total of 85 miles of track. In the entire electric zone, which will take in a total of 52 miles of line, there will be 224 miles of main and 68 miles of yard tracks, or a total track mileage of 292 miles. All tracks within this territory are laid with 100-lb. rails.

All of the sub-stations are fire-proof structures and the aim has been to make the path of the electrical energy from the high-tension transmission lines to the direct-current feeders as direct and as short as possible. The wiring is for the most part enclosed and yet it is all readily accessible. The machinery and operating boards are on the same floor and all the apparatus, including direct and alternating-current switches and circuit-breakers, is under direct electrical control of the operator at the board. The risk of accident to the operator when operating switches is eliminated and his control over the apparatus very thorough. The apparatus is arranged in the following general order across the sub-stations: High-tension lines, high-tension switching apparatus, transformers, rotaries, direct-current switching apparatus. Along the station there is a succession of complete units made up as described above, the controlling board being

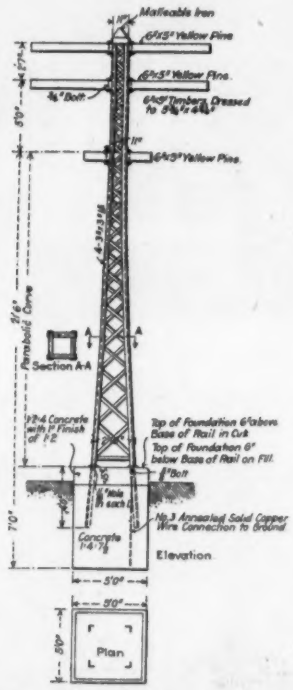

Malleable Iron
6"x3" Yellow Pine
6"x3" Yellow Pine
¾" Bolt
6"x6" Timbers Dressed to 5½"x 5½"
6"x3" Yellow Pine
Parabolic Curve
Section A-A
1:2:4 Concrete with 1" Finish of 1:2
Top of Foundation 6" above Base of Rail in Cut
Top of Foundation 6" below Base of Rail on Fill
No. 3 Annealed Solid Copper Wire Connection to Ground
Concrete 1:4:8
Elevation
Plan

FIG. 3.—PLAN, ELEVATION AND SECTIONS OF STANDARD POLE.

located at the center of the station. The concealing of the wires necessitated the use of wall chases for the high-tension lines and determined the use of transformers having high and low-tension terminals underneath the floor. The switches and circuit-breakers for both the high-tension alternating and the low-tension direct current are all electrically operated. Reference to the engravings will show that the spacing of the machinery is ample and that a very complete system of barriers is introduced for protection from live conductors.

At the sub-stations the high-tension current is transformed and converted into direct current at 666 volts for delivery to the railway circuits. The main equipment of each sub-station consists of three rotaries and their transformers and subsidiary apparatus. The arangements provide for a future installation of two additional rotaries. The relative locations and capacities of the sub-stations are shown in the accompanying table:

Sub-Sta. No.	Location.	Area or Main Floor, sq. ft.	Miles from Grand Central Station.	Present Installation of Rotary Converters.
1	50th St. and Lexington Ave..	4,796.6	.36	3 of 1,500 kw
2	Mott Haven Junction.....	3,845.27	*5.47 †5.49	3 of 1,500 kw
3	Kingsbridge	3,845.27	9.44	3 of 1,000 kw
4	Yonkers	3,639.33	15.64	3 of 1,000 kw
5	Irvington	3,845.27	22.11	3 of 1,000 kw
6	Ossining	3,845.26	30.31	3 of 1,000 kw
7	Bronx Park	3,845.27	9.30	3 of 1,000 kw
8	Scarsdale	3,845.27	19.02	3 of 1,000 kw

* Hudson division.
† Harlem division.

Each sub-station is provided with a battery equipment and provision is made for any extensions which may be required owing to increase in traffic.

The underground lines enter the basement through ducts and are terminated at end bells where they divide into three separate conductors running to three series transformers which supply current to the measuring instruments. The scheme adopted for the entrance of the overhead conductors is believed to afford the best protection against rain and snow not only to the incoming lines, but also to the apparatus in the building. The design of the lightning arresters was made with a view to separating the phases as much as possible and to make all parts accessible. The groups of arresters are mounted in such a way that a complete set may be removed and replaced without skilled labor, a feature which is supposed to be original with this installation. Knife switches disconnect all overhead lines from the sub-station apparatus.

Concrete is used for the high-tension bus-bar compartments and these are provided with concrete barriers to separate the lines connected to the bus-bars. The series transformers for the measuring instruments are suspended from the ceiling in a row near the bus-bar compartments and are separated by barriers. In order to obtain this uniform arrangement and yet leave the front terminals of the oil switches dead when not in use, the high-tension lines between the series transformers and the power transformers are looped under the bus-bar compartment. The wiring, where bare, is of copper tubing, which gives an excellent mechanical construction. The high-tension bus-bars are supported rigidly; but in such a way that expansion and contraction are possible. All openings in the bus-bar compartments are protected by fire-proof doors.

The oil switches are electrically operated and are designed to carry a considerable overload. They are provided with pilot lamps to indicate at the control board whether they are open or closed and the lamp circuits are so arranged that unless the plungers complete their stroke without rebounding there is no indication. The compartments are of buff-colored brick and the barriers between phases are of soapstone.

Two of the sub-stations are equipped with single-phase, 550-kw transformers to supply the 1,500-kw rotaries, whereas the stations with the 1,000-kw rotaries have 375-kw transformers. These have a normal ratio of 11,000 volts to 460 volts and are provided with extra taps for varying the voltage according to the drop in the transmission lines or according to the distribution of load among the sub-stations. The transformers are of the air-cooled type, with terminals underneath. The air is supplied by two induction-motor-driven blowers, one of which is sufficient to supply the station. The rotaries are of the sextuple connection, three-phase type, which combines the advantages of the ordinary three-phase and six-phase type. They convert the alternating current at 460 volts into direct current at 666 volts as stated before.

The direct-current switches and circuit-breakers are motor-operated. The design and situation of the switchboards are clearly shown in the engravings. The switches and breakers are positive, rapid and safe in action to a degree hitherto unknown with this type of apparatus. A spare panel and auxiliary bus are provided, to which any feeder or machine may be connected pending repairs on its proper panel. All connections are made with copper bars, thereby insuring a neat and effective construction. The positive feeders after leaving the switchboards are provided with end bells, which terminate the lead sheathing of the cables run out to the third rail in underground ducts. The negative leads from the rotaries run through the foundations and connect to an ammeter shunt which carries the entire station output. The negative feeders are bare 2,000,000-cir.-mil cables, which run out directly to the tracks in pipes.

There are two controlling boards situated at the center of each sub-station when it is extended to its final limits. A bench board carries the principal instruments and control apparatus and an upright board carries the auxiliary control apparatus for lighting, etc. All panels are of natural slate, with black finish, the instrument cases being black oxidized.

The electric storage battery equipment is believed to be the largest railway battery installation in the world. It not only takes care of the fluctuations of the load, but it is sufficiently

large to operate the entire system under normal conditions for a period of one hour, in case of failure of the generating apparatus. Five of the batteries have an output of 2,250 amp. for one hour and the others have outputs of 3,000, 3,750 and 4,020 amp., respectively. The batteries are located in buildings adjoining the sub-stations and are operated in connection with boosters and switching apparatus in the sub-station. The discharge is governed by a carbon regulator working in connection with exciters and boosters, the effect of which is to make the batteries discharge when there is a heavy demand for current and to charge when the demand is light.

Sub-station lighting is done with incandescent lamps fed from 120-volt alternating-current circuits. The current is taken from the 460-volt power circuit and the voltage is reduced by separate transformers. The distribution of the lamps is such that the apparatus is well lighted and the general illumination of the station is good. The wires are all placed in conduit and the circuits are controlled from standard panel boxes set in the walls. The wires in the battery room are lead-covered and the lamp sockets are of porcelain in order to withstand the action of the acid fumes. Emergency lighting current may be taken from the control battery or charging set.

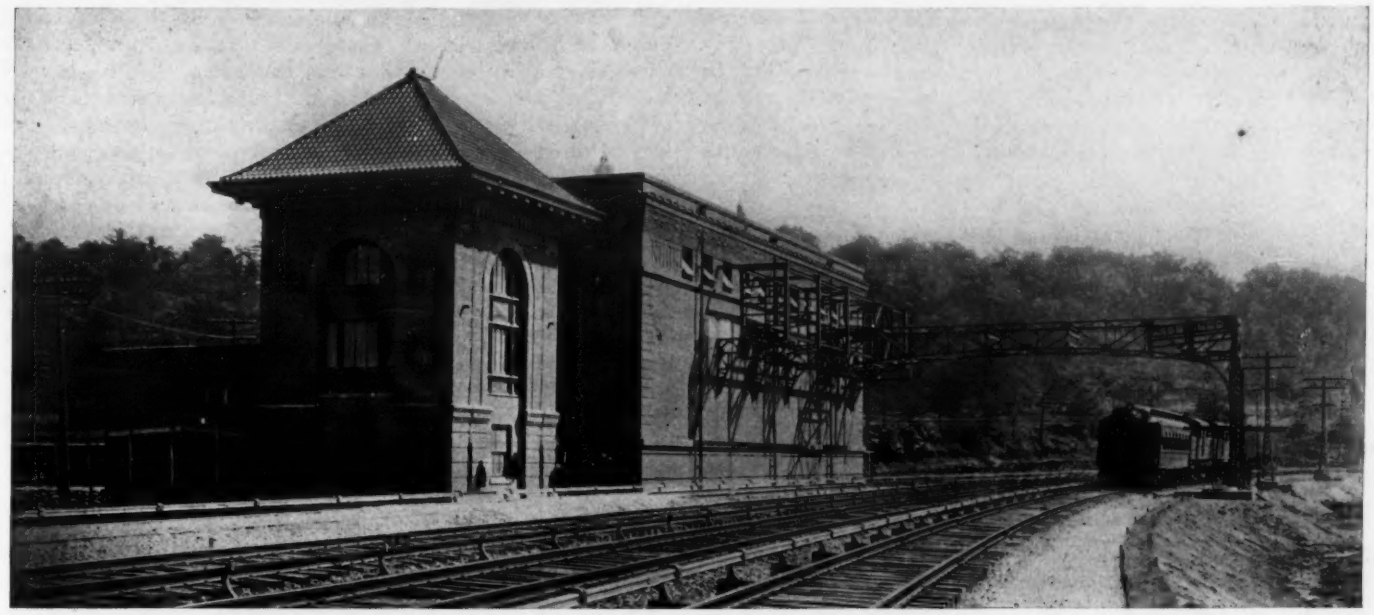


Fig. 4.—Kingsbridge Sub-Station, Showing Overhead Transmission Lines and Track.

The rotaries may be started from either side. When started from the alternating-current side a gradual application of voltage is insured by taking current from several taps in the secondaries of the power transformers. Starting from the direct-current bus-bars, the machine is brought up to speed as a direct-current motor through a rheostat, the positive bus being used as source of current. When a speed above synchronism is reached, the direct-current circuits, including the shunt field, are opened and the machine runs by its momentum only. The alternating-current circuit is then closed through the oil switch and the machine runs as a synchronous motor. It is then only necessary to close the shunt field circuit to put the machine in synchronism. These operations are made to follow each other rapidly, and are effected by the use of a special combination switch.

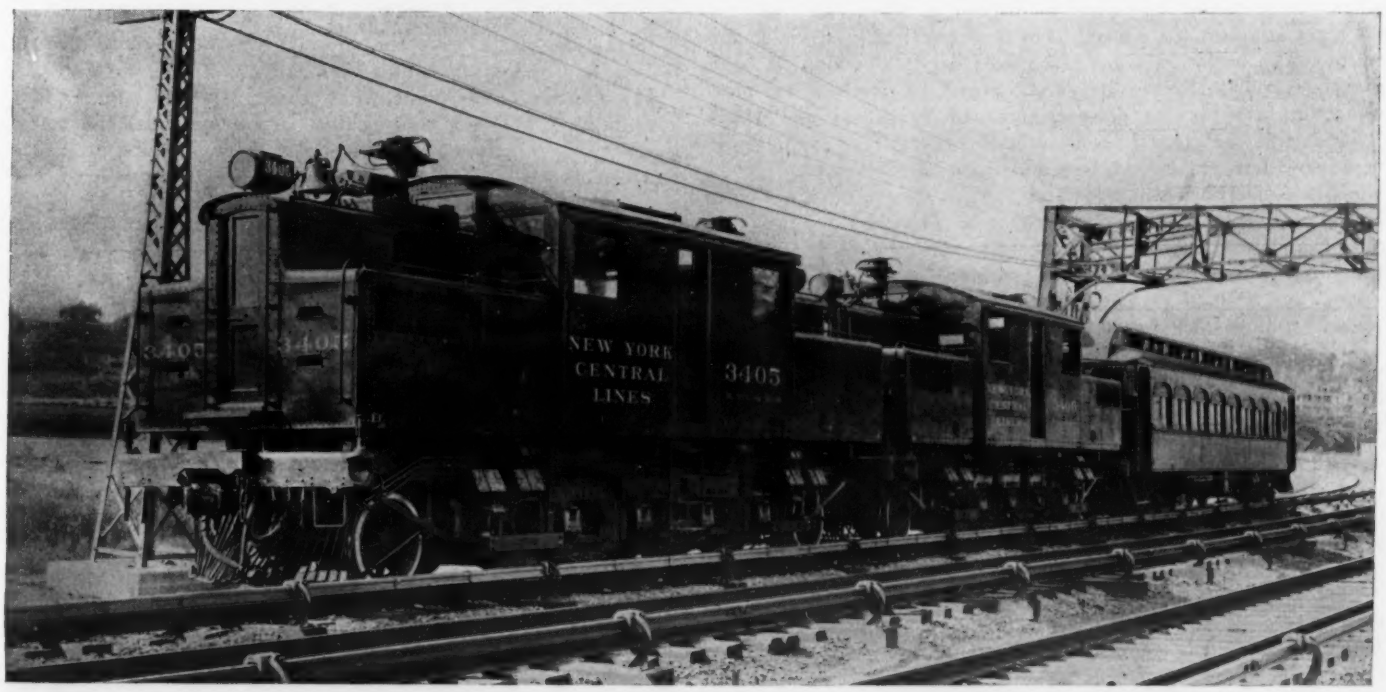


Fig. 5.—Standard Locomotives and Steel Suburban Motor Car.

The direct-current feeder system is designed to give a duplicate path for the current from the sub-station to the third rail. It is also designed so as to confine any trouble which may occur to one track only, thereby making interruptions of traffic as slight as possible. A train length section of rail is separately fed from each sub-station, to prevent trains bridging between main sections. All direct-current cables are installed in tile conduit close to the tracks, except in some cases where auxiliary

feeders join the bus-bars of consecutive sub-stations and supplement the conductivity of the third rail. These are in some localities run overhead on the transmission poles. The four third rails and auxiliary feeders are joined together through circuit-breakers situated in small houses at intervals along the line.

The transmission system in the initial electric zone includes 12 miles of conduit territory, 89 miles of cables in conduits, 6 miles of pole line territory which requires 48 miles of cables on poles, 220 splicing chambers, 9 circuit-breaker houses and one cable tower. The approximate weight of the copper necessary for the transmission wires in this territory is 1,500,000 lb. In the entire electric zone there will be 16 miles of conduit, 97 miles of cables in conduits, 46 miles of pole lines and 344 miles of cables on poles, with 383 splicing chambers, 26 circuit-breaker houses and three cable towers. The copper for the transmission system will weigh approximately 3,000,000 lb.

The working conductors in the initial zone include 75 miles of track equipped with a 70-lb. under-contact third rail and three miles of overhead construction. There are 285 circuit-breakers and switches used in connection with the working conductors, 14,000 linear ft. of jumpers and 43,000 running track bonds in this zone. The whole zone includes 285 miles of track equipped with a third rail, 5 miles of overhead construction, 450 switches with working conductors, 37,000 ft. of jumpers and 136,000 running track bonds. The third rail is of special bullhead section with high electrical conductivity. It is supported by cast-iron brackets bolted to long ties on 11-ft. centers. Insulators fit loosely over the top and web of the rail, thus allowing some vertical play. A clamp fits around the side and top of the insulator and is bolted to the bracket. The top and sides of the third rail are covered with Georgia pine as shown in one of the illustrations. This fits snugly around the rail and affords a protection against accidental contact. The protection comes in about 6-ft. lengths. A plan, elevation and section of the standard pole for transmission lines are shown in the detail drawing of Fig. 3.

The rolling stock to be used includes electric locomotives and electric motor cars. The locomotives are to be used in hauling the through trains on the Hudson division in and out of the Grand Central terminal. In the initial electric zone High Bridge will be the engine terminal for steam locomotives. Later on when the proposed extension to Croton is made, that will be the point at which the electric locomotives will pick up the steam trains. The motor cars are to be used for local trains on both the Harlem and Hudson divisions. Steam locomotives will pick up these cars for the present north of Wakefield and High Bridge until the electrification is further completed. The company now has 221 locomotives and cars for this service, 35 of which are electric locomotives and 125 are all-steel, multiple-unit motor cars, each with a normal capacity of 400 hp, weighing 53 tons complete. There are 55 all-steel multiple-unit trailer cars weighing 41 tons complete and 6 combined baggage and express motor cars, each of 400 hp. The total normal horse-power of the electric rolling stock is 129,400, the normal capacity of the locomotives being 2,200 hp. The maximum speed of the locomotives is from 40 to 80 miles an hour, depending on the weight of the train, which will range from 250 to 900 tons. The maximum speed of the multiple-unit suburban trains is 52 miles per hour.

With the electrification of the road, the existing signals and interlockings will be almost entirely replaced. All-electric, automatic signals and interlocking plants involving the use of alternating-current track circuits in combination with a direct-current propulsion system will take the place of the manually-controlled and electropneumatic automatic signals and the low-pressure pneumatic and mechanical interlocking plants now in use. When the system is complete there will be 51 interlocking plants with 1,705 levers, 564 blocks, four miles of four-way ducts and 702 miles of pole line wires. On the 292 miles of track mileage there are to be 51 signal towers, 41 battery houses, 8 signal sub-stations and 108 signal bridges. With the electrification of the road a change will be made from left-handed to right-handed running, which method has heretofore prevailed south of Spuyten Duyvil and on the entire Harlem division as far as double-tracked.

The Grand Central Station will be entirely rebuilt with tracks at two levels below the street, the upper level being for express trains and the lower level for suburban trains. Including subways, tracks and streets—the depth from the street level to the lowest part of the terminal being 80 ft.—there will be four levels. At present the excavation for the east side of the new Grand Central yard is practically completed and with the beginning of electrical operation all trains of the Harlem division and Yonkers, Croton and Peekskill locals on the Hudson division will run into this new depressed yard, discharging their passengers into the Grand Central Palace, which has been converted into a temporary station. The new terminal will have an area of 22 acres in the suburban station and 39 acres on the express level, and will include 25 miles of tracks with a car capacity of 12,000 cars. Counting new subways which are projected there will be three connections for interchange of passengers with underground rapid transit systems. The number of platform tracks will be 41. In the entire electric zone there will be 23 new passenger stations.

As stated in the previous article, the change over from steam to electricity will take place late in October or early in November. By that time or shortly after it is expected that the New York, New Haven & Hartford Railroad, which will use the overhead alternating-current system on its line from Wakefield to Stamford, Conn., and direct current between the former station and the Grand Central terminal, will also change over from steam to electricity, and the operation of both railroads will be watched with interest.

Three-Phase Traction in the Simplon Tunnel.

OUR columns have contained from time to time brief reference to the electrical equipment of the Simplon Tunnel which has been constructed on the road between Brigue and Iselle in order to afford a direct route through Switzerland to Italy. This tunnel is 12 miles in length, so that the ventilation required if steam locomotives were used would present a most difficult problem. The necessity for the elimination of smoke determined the adoption of electric traction, while the short time allowed for designing, building and installing the equipment compelled the adoption of three-phase locomotives, two of which were in process of completion, and the others in operation at the time the contract was awarded to Brown, Boveri & Co. less than one year ago.

The working of the tunnel as at present arranged requires four locomotives. When a train arrives at one terminal the steam locomotive is replaced by an electric locomotive which is in turn replaced by a steam locomotive when the train reaches the other terminal. Two of the locomotives were initially intended for extensions to the Valtellina line, while three other locomotives were borrowed from the Valtellina Railroad, one locomotive being held in reserve. The electrical energy for operation is being obtained at present from the two hydro-electric stations which had been installed for supplying the electricity used in the construction of the tunnel. The stations are equipped with three-phase generators which supply 16-cycle current at 3,300 volts directly to the working circuit which consists of two overhead conductors and the track rails.

The whole overhead construction is exceedingly solid. Outside the tunnel the line is carried on steel cross wires strained between poles of drawn steel, which are placed on either side of the track. In the tunnel itself the conductors are carried on steel cross wires, which are stretched between gun-metal studs, cemented directly into the face of the tunnel, as shown in Fig. 4; no strain insulators are used, as it is necessary to keep the overhead work in the tunnel as simple and as strong as possible. The cross wires are insulated at each end from the gun-metal studs by strong porcelain insulators, the method of attachment being such that the cross wires can be drawn as tight as required. The spacing of the cross wires on the straight portions of the line is about 83 ft., and about 42 ft. on the curves. It has not been found necessary to place the suspensions closer together, as the temperature in the tunnel is practically constant, and the conductors can be strained very tightly, so that the sag of the latter is quite small, even with spans of 80 ft. or more.

For the purpose of ensuring high insulation under the most unfavorable conditions in respect to dirt, moisture, etc., the insulators are double, being partly of porcelain and partly of ebonite. The ebonite portion is made in the form of a bolt, to which the conductor is attached; this bolt is carried by a gun-metal cross-piece fixed at each end in strong porcelain insulators by means of hemp and asbestos. The complete insulator is carried in a gun-metal fitting, by means of which it is attached to the cross wire.

The design of the insulator is such that should one portion become defective the insulation of the other will be amply sufficient to prevent harmful leakage, and thus the service can go on without interruption until a suitable opportunity occurs for replacing or repairing the insulating block. Repairs to the latter can be carried out exceedingly quickly, as all parts of the insulators are separately replaceable. Each insulating block will easily withstand a test pressure of 40,000 volts, which is amply sufficient for a working pressure of 3,300 volts, even under the most unfavorable atmospheric conditions.

The section of the conductors employed is 0.15 sq. in. in the tunnel, and 0.0775 sq. in. outside, a larger section being necessary in the tunnel in order to keep the pressure drop in the 12 miles of conductor within proper limits. In the tunnel each conductor consists of two wires, the diameter of each being 0.315 in. It was considered preferable to employ two wires per pole rather than one wire of larger diameter, firstly, because the smaller wires are far more easy to handle; secondly, because the fact of having two wires per pole ensures a better contact on the bow collectors; and thirdly, because the diameter of 0.315 in. is the largest in general use for overhead contact wires, and it is possible to obtain wires of this diameter which are thoroughly homogeneous and uniformly hard. In addition to these advantages, the supply is not interrupted if one of the wires breaks, for current can still be supplied by the second conductor until pressure can be taken off the line and the damaged conductor replaced. In order to equalize the wear on the bow collectors as much as possible, the overhead conductors are not kept exactly parallel to the track rails along their whole length, but are arranged to zig-zag slightly on the cross wires.

The track rails are bonded with the patent Brown Boveri plastic bond, the leading feature of which is that the ordinary fish-plates are used to conduct the current from one length of rails to the next, no copper connections being employed. Tests

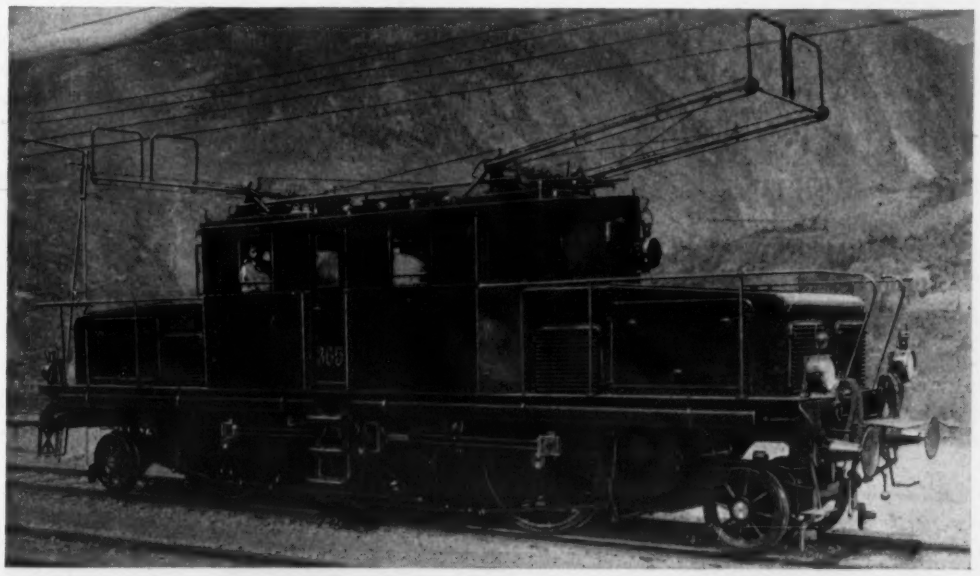


FIG. 1.—THREE-PHASE LOCOMOTIVE FOR SIMPLON TUNNEL.

recently carried out at Brigue have shown conclusively that the conductivity of the bonds is as good as that of the homogeneous rails.

Fig. 1 illustrates the construction of the Brown Boveri locomotives, and it will be seen that these are of the bogie type, with five axles altogether, three of which are driven by the motors. The two motors are placed between the three pairs of driving wheels, and both drive on to the middle axle by means of a bar coupling them rigidly together. This axle in turn drives the other two axles by means of a coupling rod. Thus the motors are gearless, and at the same time they are not

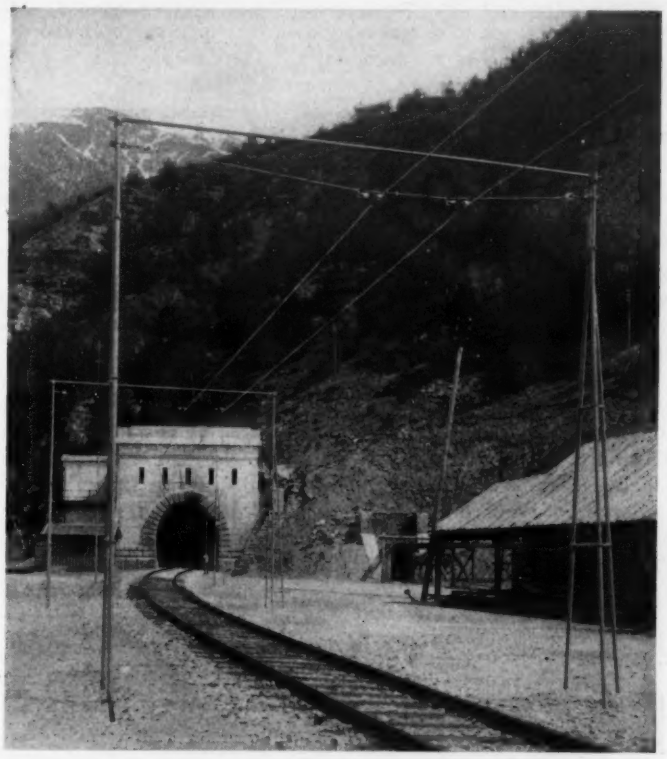


FIG. 2.—ENTRANCE TO SIMPLON TUNNEL AT BREGUE.

directly keyed on to the driving axles of the locomotive; it was considered advisable not to adopt the latter plan, for the dismounting of the motors in this case would be much more difficult.

The full-load rating of each motor is 450 hp, at from 2,700 to 3,000 volts and 16 cycles. At the higher speed the short-period overload capacity of each motor is as high as 1,150 hp, while at the lower speed (at which the full-load rating is 390 hp) each motor can be continuously overloaded up to 575 hp.

The control of the motors is effected by means of secondary resistances in combination with altering the number of primary poles, this method being adopted in preference to the system employed by the Ganz Company, on the Valtellina line, of coupling the motors in tandem. By working with two combinations of poles and rheostatic control it has been possible to reduce the weight of each motor by about 2½ tons, and it is thought that these motors are the lightest which have yet been constructed for their output. The motors are now completely enclosed, in order to protect them against the bad climatic conditions of the tunnel, the hot air in which is mostly saturated with moisture.

The pole changing of the motors is effected by means of a mesh-star combination of the primary windings, by which either 16 or 8 poles can be made, corresponding to speeds of 112 and 224 r.p.m. respectively. The secondaries are provided with six-phase windings, so arranged that when the number of poles is changed on the primary no modification whatever is required of the secondary.

The locomotives are arranged for operation from either end, there being two controllers, etc. Current is collected by means of bow collectors from the overhead conductors, from which, after passing the lightning arresters, it is led to the line switches and then to the emergency switch, which is placed in the roof of the locomotive. From this the circuits pass directly to two bus-bars and then through fuses to a reversing switch, which controls the direction of working of the locomotive. Then they pass to a pole-changing switch, and finally to the motors themselves.

The controller, shown with the cover removed in Fig. 5 controls the reversing switch, the pole-changing switch and the rotor resistances of the motors, there being a controller at each end of the locomotive. Each is provided with two handles and a hand wheel, the first handle being for the pneumatic operation of the reversing switch, the other for the pneumatic operation of the pole-changing switch, and the hand wheel for the control and operation of the rotor resistances. The reversing and pole-changing switches are actuated by means of compressed air relays, and can be operated equally well by either controller.

The resistances are placed at each end of the locomotive under extensions of the cab, there being one set for each motor, and the contacts are mounted directly upon them; it is these contacts which are actuated by gearing from the controllers, and it will be apparent that the removal of the contacts themselves from the controller proper not only simplifies the construction and enables a better job to be made, but it renders the inspection or repair of the contacts very easy.

The resistances proper are of rheostane strips, mounted in

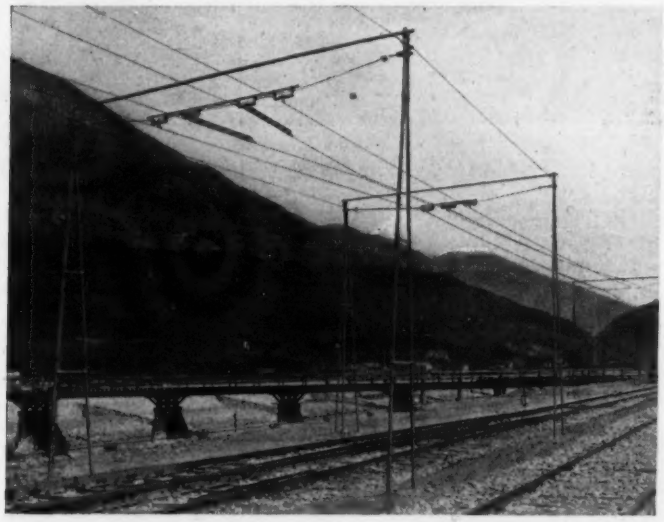


FIG. 3.—OVERHEAD WORK OUTSIDE THE TUNNEL.

frames sliding in slots, so that each resistance unit can be taken out independently, and thus inspection and repairs can be readily carried out.

An interesting detail in connection with the design of these resistances is that they are artificially cooled by means of four blowers, placed in pairs at each end of the locomotive. These blowers are operated by means of small three-phase motors connected to the external secondary circuits of the motors. Thus, the blower motors start up when the main motors start, and when the latter are at full speed (with short-circuited slip rings) they are automatically cut out of circuit, for ventilation of the resistances is then no longer required.

The admission valves, controlling the action of the relays for the different apparatus enumerated above, are all interlocked, either pneumatically or mechanically. Both the reversing switch and the pole-changing switch operate under oil, and the same remark applies to the emergency switch in the roof. The latter can be opened in three different ways; first, by hand by the driver; secondly, electrically, by a maximum current relay; and thirdly, pneumatically, by an air relay. The object of the latter provision is in order to prevent possible damage to the motors should the train be brought too quickly to a standstill by the injudicious operation of the air brakes.

A 7-kw oil-cooled transformer supplies the necessary power at 110 volts for the air-compressor motors and for part of the lighting. The air compressors are of the standard Christensen type, there being two compressors and four reservoirs, the latter being mounted in pairs at each end of the locomotive; each compressor is designed to supply 14.5 cu. ft. of air per minute at a pressure of 110 lb. to the square inch. The compressors may

FIG. 4.—OVERHEAD CONSTRUCTION IN TUNNEL.

be started by hand, or automatically by an electromagnetic governor, which disconnects the motors as soon as the pressure rises to 110 lbs., and switches them on again when the pressure falls below a certain minimum. All of the compressed air pipes are fitted with return valves, so that they may be operated from either of the two controllers, and thus if either controller is out of order, the other can be used.

The design of the current collectors (Fig. 6) has been the subject of much careful consideration. As will be seen from the illustration of the locomotive, two bow collectors are provided, one at each end of the locomotive roof. Each collector is formed of two main parts, the lower being a hinged frame and the upper the collector proper, which is pivoted to the upper end of the frame.

The collector is so arranged that on the outside tracks, where the overhead conductors are 17 ft. from the ground, the upper part of the collector alone comes into action, while in the tunnel,

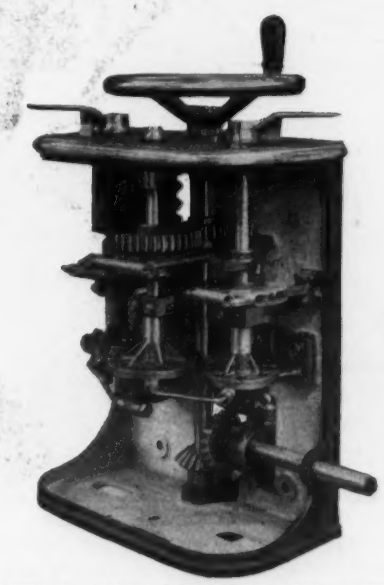


FIG. 5.—MAIN CONTROLLER MECHANISM.

where the height of the overhead conductors from the ground is reduced to 15 ft. 9 in., the main frame makes a correspondingly smaller angle with the horizontal.

The bow collector is kept in contact with the overhead conductors by means of a compressed air piston, which piston acts upon

a controlling spring so as to raise or lower the collector. If the locomotive has been standing (no compressed air being available) the air cylinder can be worked by means of a small manually-operated air pump, thus raising the collectors and making contact with the line; as soon as this takes place the motor compressors at once start.

All of the high-pressure switch gear and apparatus is enclosed in a sheet metal case, the opening of which can be effected only when the bow collectors are not in contact with the line.

The general design of the locomotives is due to the joint deliberations of the engineers to the Valtellina Railway with Messrs. Brown, Boveri & Co., and the Swiss Locomotive Works of Winterthur, which latter firm constructed the framework and other non-electrical parts of the locomotives for Messrs. Brown, Boveri & Co. The following are the leading particulars of these locomotives:

Overall length (between buffers)	40 ft. 6 in.
Distance between centers of bogie axles	31 ft. 10 in.
Distance between centers of outside driving axles	16 ft. 1 in.
Distance between centers of bogies	23 ft
Diameter of the driving wheels	5 ft. 4½ in.
Diameter of the bogie wheels	2 ft. 9½ in.
Weight on the driving wheels	42 tons.
Weight of the mechanical portion of the equipment	34 tons.
Weight of the electrical portion of the equipment	28 tons.
Total weight of locomotive, complete	62 tons.
Rated full-load output of the two motors together	900 B.H.P.
Maximum output of the two motors together	2,300 B.H.P.
Weight of each motor complete with its coupling bar	10¾ tons.
Normal speeds of the locomotive	42 miles and 21 miles per hour.
Draw-bar pull of locomotive at 42 miles per hour	7,700 lb. normal. / 20,000 lb. maximum.
Draw-bar pull of locomotive at 21 miles per hour	13,500 normal. / 31,000 maximum.

It will be seen that the locomotives are built on liberal lines. When starting at the higher speed with a passenger train weighing 300 tons a draw-bar pull of 16,600 lb. is required in order to obtain the specified acceleration of 0.5 ft. per second, per second, and when starting at the lower speed with a freight train weighing 400 tons a draw-bar pull of 20,000 lb. is required in order to obtain the specified acceleration of 0.36 ft. per second per second.

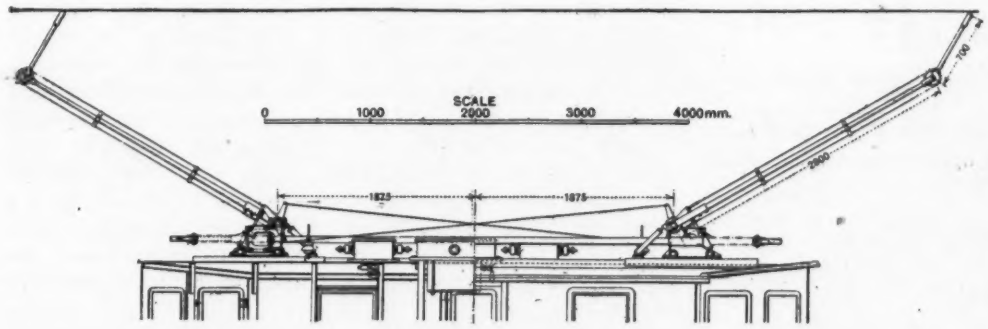


FIG. 6.—ARRANGEMENT OF CURRENT COLLECTORS.

The remaining locomotives, which are now in course of construction, will differ in certain details from the first two locomotives, as described above, as it has been found possible to simplify the controlling gear still further; but in all essential respects they will be as above described, the general performance of the locomotives being considered excellent.

Fire-Proof Insulating Material.

An insulating material which is stated to possess high dielectric strength, to be fire-proof and non-shrinkable is the subject of a patent issued recently to Mr. George Kelley. The material first formed consists of five parts by weight of pontianak gum and ninety-five parts of liquid glass; that is, silicate of sodium or silicate of potassium. The liquid glass acts as a solvent for the gum, the resultant combination having excellent adhesive qualities. Sufficient mineral wool is moistened with the above combination to make a stiff but plastic body. The material is formed into sheets or molded articles which are subsequently valcanized under pressure until the desired degree of hardness is attained. It is stated that the article thus obtained is suitable in every way for insulating purposes. The patent contains eleven claims, two of which read as follows: 1. The method of manufacturing insulating material which consists in combining liquid glass, gum and mineral wool and vulcanizing the same. 10. As an article of manufacture a vulcanized insulating body including fibre, vegetable gum and liquid glass.

The Distribution of Illumination in the Neighborhood of a Row of Lamps.

BY J. R. BENTON.

THE illumination of large rooms or halls is very frequently effected by means of rows of lamps placed along the walls near the ceiling. In designing such an arrangement it is desirable to have some way of ascertaining in advance what illumination may be expected at any point from a given row of lamps, or what arrangement of lamps in a row will produce an assigned intensity of illumination at a given point. It is the purpose of this note to state formulas from which this information can be obtained, and to call attention to some of their more important consequences.

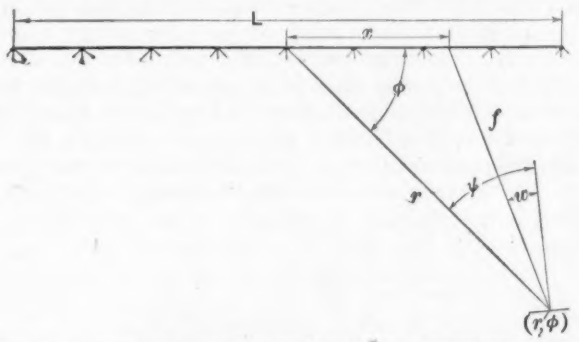


FIG. 1.—DIAGRAM TO ILLUSTRATE MEANING OF SYMBOLS IN THE FORMULAS AND TABLES.

The case of a single straight row of lamps will be taken up first, and afterwards two parallel rows will be discussed. It will be assumed throughout that each lamp gives the same candle-power in all directions, which would be approximately true for incandescent lamps; and that the lamps are equal to each other and uniformly spaced.

The distribution of illumination about a single row of lamps is obviously symmetrical with respect to the row as an axis. We have then merely to investigate the illumination at all points of a plane passing through the row of lamps, and the results will be applicable to all other planes passing through the row. The position of points in one of these planes may be most conveniently defined by means of polar co-ordinates, taking as origin the center of the row, as illustrated in Fig. 1. Let I be the intensity of illumination (in candle-meters) upon an element of surface at a distance r (in meters) from the center of the row of lamps, and let ϕ be the angle between r and the row of lamps. Let L be the length of the row (in meters) and let C be the total candle-power of all the lamps in the row. Let i be the angle of incidence of the light upon the element of surface; that is, the angle between r and the perpendicular to the surface. Let X be the angle between that perpendicular and the plane containing r and L; and let Ψ be the angle between r and the projection on that plane of the perpendicular to the element of surface. Then I is given by the formula:

$$I=\frac{C}{rL}\left[\cos\Psi\left\{\frac{L/2}{\sqrt{r^2+L^2/4-rL\cos\phi}}+\frac{L/2}{\sqrt{r^2+L^2/4+rL\cos\phi}}\right\}+\frac{\sin\Psi}{\sin\phi}\left\{\frac{L/2\cos\phi-r}{\sqrt{r^2+L^2/4-rL\cos\phi}}+\frac{L/2\cos\phi+r}{\sqrt{r^2+L^2/4+rL\cos\phi}}\right\}\right]\cos X \quad (1)$$

The derivation of this formula is given at the end of this article. It is based on the assumption that the lamps are so closely spaced that they may be treated like a continuous line of light; when they are very widely spaced, the formula is only approximately exact. Instead of the meter the foot may be used as unit of length in this formula, and then the result comes out in candle-feet.

This formula is applicable with perfect generality, provided all of the light falls upon one side of the element of surface; but if the latter is so placed as to be illuminated on both sides by the row of lamps, the formula no longer expresses the conditions correctly.

If the element of surface upon which illumination is received is turned into different positions without leaving the point $(r\,\phi)$, the intensity of illumination will vary with the varying angle of incidence. It is important to find the maximum intensity of illumination which can be obtained at any point. It is this quantity which would determine whether the illumination at any point is sufficient for reading, since a person would naturally turn his book into the position in which it received the maximum illumination. The maximum illumination is given by the following formula (derived below), in which ρ is an abbreviation for the ratio r/L:

$$I_{max} = \frac{C}{L^2} \cdot \frac{\sqrt{2}}{\rho \sin\phi} \sqrt{1 + \frac{1}{\sqrt{1 + \left(\frac{\rho \sin\phi}{0.25 - \rho^2}\right)^2}}} \qquad (2)$$

or

$$= \text{even } I \begin{cases} \frac{C}{L^2} \cdot \frac{\sqrt{2}}{\rho \sin\phi} \sin\left[\tfrac{1}{2} \tan^{-1} \frac{\rho \sin\phi}{0.25 - \rho^2}\right] \text{ for } \rho > 0.5 \\ \frac{C}{L^2} \cdot \frac{\sqrt{2}}{\rho \sin\phi} \cos\left[\tfrac{1}{2} \tan^{-1} \frac{\rho \sin\phi}{0.25 - \rho^2}\right] \text{ for } \rho < 0.5 \end{cases} \qquad (3)$$

provided the inverse tangent is always taken as in the first quadrant.

This formula furnishes the data from which Fig. 2 is drawn, showing graphically the distribution of light in the neighborhood

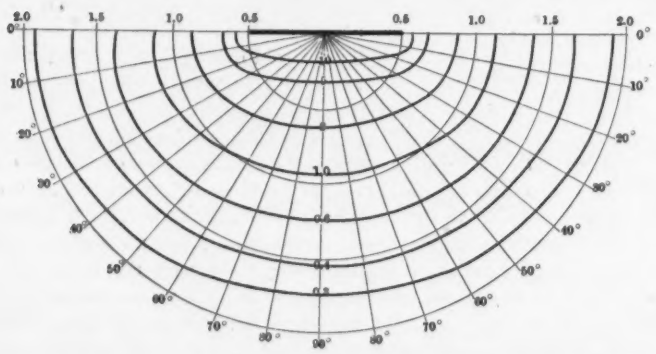


FIG. 2.—CURVES OF EQUAL INTENSITY OF ILLUMINATION IN THE NEIGHBORHOOD OF A ROW OF LAMPS.*

of a single row of lamps. Table I, given herewith, contains values of the coefficient of C/L^2 in the above formula, from which I_{max} can readily be found, as will be illustrated by a few examples.

TABLE I.

Values of $\frac{\sqrt{2}}{\rho \sin\phi} \sqrt{1 + \frac{1}{\sqrt{1 + \left(\frac{\rho \sin\phi}{0.25 - \rho^2}\right)^2}}}$ to be used in finding the intensity of illumination (I_{max}) at the point, (r, ϕ), in accordance with the formula $I_{max} = \frac{C}{L^2} \frac{\sqrt{2}}{\rho \sin\phi} \sqrt{1 + \frac{1}{\sqrt{1 + \left(\frac{\rho \sin\phi}{0.25 - \rho^2}\right)^2}}}$

where C = total candle power of all the lights together, L = length of the row, and $\rho = r/L$.

ϕ=	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
ρ										
0.2		57.4	28.9	19.5	15.0	12.41	10.9	9.94	9.44	9.28
0.25		45.8	22.9	15.3	11.7	9.63	8.40	7.67	7.29	7.16
0.30		37.9	18.7	12.4	9.39	7.71	6.72	6.13	5.81	5.72
0.35		32.1	15.5	10.2	7.68	6.31	5.50	5.01	4.76	4.68
0.40		27.2	12.9	8.50	6.34	5.23	4.57	4.17	3.97	3.90
0.45		22.3	10.5	6.90	5.27	4.37	3.84	3.52	3.36	3.30
0.5		16.29	8.27	5.66	4.40	3.69	3.27	3.01	2.87	2.83
0.6	9.09	7.10	5.00	3.82	3.12	2.70	2.42	2.26	2.16	2.13
0.7	4.17	3.82	3.19	2.66	2.29	2.06	1.85	1.74	1.68	1.66
0.8	2.56	2.45	2.20	1.96	1.73	1.57	1.46	1.38	1.33	1.32
0.9	1.79	1.72	1.62	1.48	1.35	1.25	1.17	1.12	1.09	1.08
1.0	1.33	1.31	1.24	1.16	1.08	1.01	0.960	0.923	0.902	0.894
1.2	0.840	0.831	0.806	0.771	0.736	0.703	0.676	0.657	0.645	0.641
1.4	0.585	0.581	0.568	0.552	0.533	0.515	0.501	0.489	0.483	0.481
1.6	0.433	0.431	0.424	0.415	0.404	0.394	0.385	0.378	0.374	0.373
1.8	0.334	0.333	0.329	0.324	0.317	0.313	0.305	0.301	0.298	0.297
2.0	0.267	0.266	0.263	0.260	0.256	0.252	0.248	0.245	0.243	0.243

As a first example, let it be required to find the maximum intensity of illumination at a point 3 meters directly below the center of a single row of lamps, of length 9 meters, and consisting of ten 16-cp lamps, spaced uniformly. We have here $C = 160$, $L = 9$, $r = 3$, $\phi = 90°$. We first determine the value of r/L or ρ, as 0.33; entering the table with $\rho = 0.33$ and $\phi = 90°$, we obtain the number 5.10. I_{max} is obtained by multiplying this number by C/L^2, or 160/81 or approximately 2, and comes out as 2×5.10, or 10.2 candle-meters.

A second example will illustrate the converse problem, to find how many 16-cp lamps, arranged in a row, are necessary to produce a given intensity of illumination. Let us suppose a hall 40 ft. long, 25 ft. wide and 15 ft. high is to be lighted by a single row of lamps at the middle of the ceiling and running the full length of the hall. How many candle-power must be provided in order that sufficient illumination for comfortable reading may be secured at all points of the hall? The darkest places will be the corners, so that if sufficient light is provided for them there will be enough at all other points. We have for the corners $r = \sqrt{(40/2)^2 + (25/2)^2 + 15^2} = 28$ ft. nearly, and $\phi = \cos^{-1} 20/28 = 44.5°$; $r/L = 28/40 = 0.7$. Entering the table with these values of r/L and ϕ, we obtain the number 2.18. We must have, then, at the point in question, $I_{max} = 2.18\ C/L^2$. If we take 0.4 candle-feet as the minimum for comfortable reading, this gives $0.4 = 2.18\ C/(40)^2$, from which $C = 294$ candle-power, the total amount to be provided. With 16-cp lamps, 19 of them will be required.

The question may arise as to whether, with the above data, any advantage would be gained by changing the value of L; that is, by making the row of lamps shorter than the hall it is to illuminate. Fig. 2 shows that there would be loss instead of gain by shortening the row. A row of lamps should, therefore, extend the full length of the hall it illuminates. There would be an advantage in having the row longer than the hall, which might be virtually realized by placing large plane reflectors at the ends of the row.

Sources of light act more effectively as they are brought nearer the surfaces to be illuminated; and it may be desirable to know how much would be gained in the present example by placing the row 10 ft. instead of 15 ft. above the floor. In this case we have for the corners $r = \sqrt{(20)^2 + (12.5)^2 + (10)^2} = 25.6$ ft.; $\phi = \cos^{-1} 20/25.6 = 39°$; $r/L = 0.64$. From the table we get 2.85. So we have $0.4 = 2.85\ C/(40)^2$, whence $C = 225$ cp. Therefore, only 14, instead of 19, 16-cp lamps would be necessary.

We may now take up the case of two equal rows of lamps, one on each side of the room.

The illumination upon an element of surface in any position at any point can be found from formula (1), by applying it for each of the rows separately, and summing the results. But a general formula for the maximum intensity of illumination at all points would be inconveniently complicated, since the maximum must be obtained for both of the variables, X and Ψ, and an additional parameter must be introduced to take account of the distance between the two rows. But all ordinary practical problems can be solved by a special case of the general formula, as will now be explained.

*The row of lamps is indicated by the heavy line at the top of the figure. The figures at the middle of each curve give the corresponding intensity of illumination in arbitrary units. The figures correspond to candle-meters if the length of the row of lamps is 1 meter and its total candle-power 1 cp. Otherwise the intensity in candle-meters can be found by multiplying the above figures by $\frac{C}{L^2}$.

Practical problems are generally concerned with securing sufficient illumination at the darkest point of a room. Now, in passing transversely across a hall illuminated by a row of lamps on each side, it is clear that the darkest point will be reached midway between the two rows; and the darkest points of the whole hall will be at the two ends, midway between the rows of lamps. The practical problems can accordingly be handled if we can obtain a formula for the maximum illumination upon an element of surface placed at the end of the row and equally distant from the two rows. Such a formula is derived below, and is as follows:

$$I_{max} = \frac{C}{L^2} \cdot \frac{(2L/w)^2 \cdot \frac{2}{\rho^2 - 0.25}\left[1 - \sqrt{\frac{\rho^2 - 0.25}{\rho^2 + 0.75}}\right] + \left\{1/2\rho^2\left[\frac{1 - 2\rho^2}{\sqrt{\rho^2 - 0.25}} + \frac{1 + 2\rho^2}{\sqrt{\rho^2 + 0.75}}\right]\right\}}{\sqrt{\left\{1 + (2L/w)^2\right\}\left\{1/2\rho^2\left[\frac{1 - 2\rho^2}{\sqrt{\rho^2 - 0.25}} + \frac{1 + 2\rho^2}{\sqrt{\rho^2 + 0.75}}\right]\right\}^2 + (2h/w)^4 \cdot \frac{2}{\rho^2 - 0.25}\left[1 - \sqrt{\frac{\rho^2 - 0.25}{\rho^2 + 0.75}}\right]}} \quad (4)$$

where C is the total candle-power of the two rows taken together, w is the distance between the two rows, h is the distance of the element of surface between the plane of the two rows, and ρ has its usual meaning of r/L, where r is the distance from the center of one row, and L the length of the row.

In order to facilitate the use of this formula, Table II gives values of the coefficient of C/L^2, or $L^2\, I_{max}/C$. The use of the table will be illustrated by some examples.

TABLE II.

Values of $I_{max}\frac{L^2}{C}$ for points midway between two equal parallel rows of lamps and in the plane perpendicular to the rows at their end. C stands for total candle-power of both rows together; w, the distance between the two rows; h, the distance from the plane of the two rows to the point at which the illumination is to be determined.

$\rho = r/L$	$2h/w = 0.6$	1.0	2.0
0.55	5.44	5.44	5.44
0.60	3.49	3.51	3.55
0.65	2.56	2.61	2.66
0.70	2.00	2.10	2.21
0.75	1.64	1.75	1.82
0.8	1.37	1.48	1.54
0.9	1.01	1.13	1.19
1.0	0.795	0.905	0.954

In the hall discussed in the last example—40 ft. long, 25 ft. wide, 15 ft. high—it is required to find the maximum illumination at the darkest point of the hall when lighted by a row of 10 16-cp lamps on each side near the ceiling. The darkest points will be near the floor at the ends midway between the two sides, and for them $r = \sqrt{(40/2)^2 + (25/2)^2 + 15^2} = 28$ ft., $r/L = 28/40 = 0.7$, $h = 15$ ft., $w = 25$ ft., $2h/w = 1.2$. We have also $C = 2 \times 10 \times 16 = 320$ cp. Entering the table with the above values of r/L and $2h/w$, we obtain the number 2.12, from which $I_{max} = 2.12\, c/L^2 = 2.12\ 320/(40)^2 = 0.424$ candle-feet.

Again, let it be required to find how much candle-power must be provided to secure 0.4 candle-feet at the darkest point of the room, the lamps to be placed only 10 ft. above the floor. We have then $r = 25.6$ ft., $r/L = 0.64$, $h = 10$ ft., $2h/w = 0.8$. The number in the table corresponding to these values of r/L and $2h/w$ is 2.76, whence $0.4 = 2.76\, C/(40)^2$, so that $C = 232$ cp, which would require eight 16-cp lamps on each side of the hall.

These results show that lighting by a row of lamps on each side of a room is rather less economical than by a single row in the middle, if the system is so designed as to give a certain prescribed intensity of illumination at the darkest point of the room. On the other hand, the two rows, being near the walls, are placed more advantageously as regards reflection from the walls.

Some economy might be effected by placing the rows a little ways inwards from the walls on each side, instead of at the walls themselves; but such an arrangement, while more effectively lighting the points midway between the rows, might leave the corners too dark. As it would frequently be inconvenient practically to support the lamps away from the walls, this case will not be discussed further.

It may be of interest to compare the candle-power required to secure sufficient illumination for reading (assumed at 0.4 candle-feet) at all points of the hall discussed above, when the sources of illumination are arranged in various ways. With a single chandelier at the center of the room and 10 ft. from the floor, we would have for the corners $r^2 = (40/2)^2 + (25/2)^2 + (10)^2 = 656$, whence $0.4 = C/656$, or the required candle-power is 262. With two chandeliers 10 ft. from the floor and 8 ft. from each end, the candle-power comes out 242, computed by the method described in ELECTRICAL WORLD, Vol. 47, p. 916, May 5, 1906. For a row of lamps along the center of the hall, we obtained above 225 cp; and for a row along each wall 232 cp; so that as far as economy alone is concerned, the best arrangement is that of a single row of lamps along the center of the hall. This will be found to hold true in general, even when the dimensions of the hall are quite different from those assumed here.

DERIVATION OF FORMULAS.

Derivation of the Formulas for a Single Row of Lamps.—Consider a number of equal point sources of light, placed at uniform intervals along a straight line. Let C be the total candle-power of the whole set, and L the length of the line; then C/L is the candle-power per unit length. If now the number of sources is increased and the candle-power of each decreased, so that the candle-power per unit length is unchanged, then the distribution of illumination will be approximately unchanged except for points very near the row. Carrying this process to the limit, we may replace our row of sources by a line of which every element (of length dx) sends out light (of candle-power $dx\ C/L$). Each element must be taken as emitting light equally in all directions, so that the arrangement differs from a luminous filament, where the intensity of light sent out in different directions varies with the cosine of the angle of emission.

A surface at a distance f (see Fig. 1) will receive from the element of line an illumination of intensity,

$$dI = \frac{C/L\ dx}{f^2} \cdot \cos i,$$

where i stands for the angle of incidence of the light upon the surface. If we integrate this expression over the whole line, we obtain the whole illumination caused by it upon the surface.

The whole system being symmetrical with respect to the row of lamps as an axis, we confine our discussion to a plane passed through the row. With the center of the row as origin, we let r and ϕ be polar co-ordinates of the point at which the illumination is to be found, and x the distance to the element of line dx, as shown in Fig. 1. We have then $f^2 = r^2 + x^2 - 2rx\cos\phi$. Suppose the normal to the illuminated surface at the point $r\phi$ makes an angle X with the plane of r and L, and the projection of the normal on that plane makes an angle Ψ with r, and an angle ω with f. Then

$$\cos i = \cos X \cos\omega = \cos X \cos\left[\Psi - (r,f)\right] =$$

$$\cos X\left[\cos\Psi\frac{r - x\cos\phi}{\sqrt{r^2 + x^2 - 2rx\cos\phi}} + \sin\Psi\sin\phi\frac{x}{\sqrt{r^2 + x^2 - 2rx\cos\phi}}\right] \quad (6)$$

whence

$$dI = \frac{C}{L} \cdot \frac{\cos X\left[\cos\Psi(r - x\cos\phi) + x\sin\Psi\sin\phi\right]}{(r^2 + x^2 - 2rx\cos\phi)^{3/2}}\,dx \quad (7)$$

Integrating with respect to x, we obtain

$$I = \frac{C\cos X}{Lr}\left[\cos\Psi \cdot \frac{x}{\sqrt{r^2 + x^2 - 2rx\cos\phi}} + \sin\Psi \cdot \frac{x\cos\phi - r}{\sin\phi\sqrt{r^2 + x^2 - 2rx\cos\phi}}\right]_{-L/2}^{+L/2} \quad (8)$$

When the limits are substituted in this expression, we obtain formula (1) as given above.

In this formula r and ϕ define the position of a point, and X and Ψ the orientation of an element of surface at that point. We have now to ascertain what values of X and Ψ at the point $r\phi$ will make I a maximum, and what the value of that maximum is. For this purpose it is convenient to introduce abbreviations into formula (1) so as to make it

$$I = \cos X \cdot (P_c \cos \Psi + P_s \sin \Psi) \qquad (9)$$

P_c and P_s are independent of X and Ψ.

The maximum intensity of illumination will occur in some orientation of the surface such that its normal lies in the plane of r and L. Accordingly $\cos X = 1$. To find what the value of Ψ should be, we have to form the derivative of I with respect to Ψ and set it equal to zero. In this way we find $\Psi = \tan^{-1}(P_s/P_c)$. Substituting these values of X and Ψ in the expression for I and simplifying, we have

$$I_{max} = \sqrt{P_c^2 + P_s^2}. \qquad (10)$$

If now the values of P_c and P_s as functions of r, ϕ, C and L are introduced, and the result simplified, we obtain finally the formulas (2) or (3), as given above.

Derivation of the Formula for Two Rows of Lamps.—The illumination at any point can be obtained by applying formula (1) separately to each row, and summing the results. If we confine our attention to points in the plane midway between the two parallel rows, we have always $r_1 = r_2$, $\phi_1 = \phi_2$, and by hypothesis $L_1 = L_2$ and $C_1 = C_2$. For maximum illumination we must have the angle of incidence the same from the two rows, so that $X_1 = X_2$ and $\Psi_1 = \Psi_2$, and the expression for the illumination becomes, from formula (9):

$$I = 2 \cos X \cdot (P_c \cos \Psi + P_s \sin \Psi). \qquad (11)$$

In finding I_{max} a complication arises from the fact that X is no longer independent of Ψ. The normal to the element of surface must lie in the plane midway between the rows, so that we have:

$$\cot X = \frac{\cot a}{\sin(\phi - \Psi)},$$

where a stands for the angle between the median plane and the plane of r and L. Accordingly $\cot a = 2h/w$, if w is the distance between the rows, and h the depth of the point $(r\phi)$ below their plane. We have then:

$$\cos X = \frac{\cot a}{\sqrt{\sin^2(\phi - \Psi) + \cot^2 a}} = \frac{2h/w}{\sqrt{\sin^2(\phi - \Psi) + (2h/w)^2}},$$

which, substituted in (11), gives:

$$I = \frac{2(2h/w)(P_c \cos \Psi + P_s \sin \Psi)}{\sqrt{\sin^2\phi\cos^2\Psi - 2\sin\Psi\cos\Psi\sin\phi\cos\phi + \cos^2\phi\sin^2\Psi + (2h/w)^2}} \qquad (12)$$

We must now find the value of Ψ for which this expression is a maximum. By setting its derivative with respect to Ψ equal to zero, we obtain:

$$\Psi = \tan^{-1} \frac{P_s[(2h/w)^2 + \sin^2\phi] + P_c \sin\phi\cos\phi}{P_c[(2h/w)^2 + \cos^2\phi] + P_s \sin\phi\cos\phi}, \qquad (13)$$

and substituting this in (12) we get

$$I_{max} = \frac{\left(\frac{2h}{w}\right)^2 (P_c^2 + P_s^2) + (P_c\cos\phi + P_s\sin\phi)^2}{\sqrt{\left(P_c\cos\phi + P_s\sin\phi\right)^2\left(1 + 2\left[\frac{2h}{w}\right]^2\right) + \left(\frac{2h}{w}\right)\left(P_s^2 + P_c^2\right)}} \qquad (14)$$

This formula is too complicated for general application; but when applied to points in the plane at the end of the rows, it becomes much simplified, since for such points $\cos\phi = \frac{L/2}{r}$. Formula (4) is thus obtained from formula (14) by introducing the values of P_c and P_s, simplifying, and changing the meaning of C so as to mean the total candle-power of *both* rows.

Gasoline-Electric Motor Truck for Difficult Transportation Work.

It has been announced that the largest telescope in the world is to be moved to its permanent location at the top of a high mountain by an extremely interesting self-contained electrically-propelled vehicle.

The telescope is the monster piece of apparatus being constructed at Pasadena, Cal., for the Solar Observatory of the Carnegie Institution at Washington, which observatory is located at the top of Mount Wilson, near Pasadena. The vehicle is a large automobile truck just completed at Grand Rapids, Mich., in the shops of the Couple-Gear Freight Wheel Company, licensees under the Holson motor patents. The car was specially designed

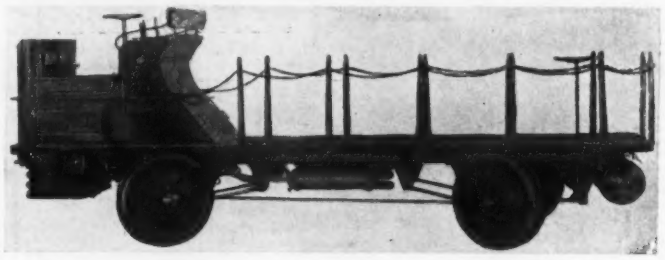


FIG. 1.—GENERAL VIEW OF GASOLINE-ELECTRIC TRUCK.

as a result of serious study of the problem of moving the heavy telescope parts to the top of the mountain.

The new telephone will have a lens 60 in. in diameter, or 20 in. larger than the objective of the Yerkes instrument, which is now the largest in the world. Work on the grinding of this immense piece of glass, which weighs a ton, has been in progress for three years, and the big instrument is rapidly nearing completion and will be placed in the observatory very soon. Aside from the heavy lens there are castings and other parts equally ponderous, for the casting of the base weighs alone five tons.

The task of moving the apparatus to the observatory, a distance of nine miles from the shops in Pasadena, was one of the most serious problems in connection with the great telescope undertaking. In this distance of nine miles there is a rise of 5,000 ft. to be surmounted. The mountain trail is precipitous, broken and full

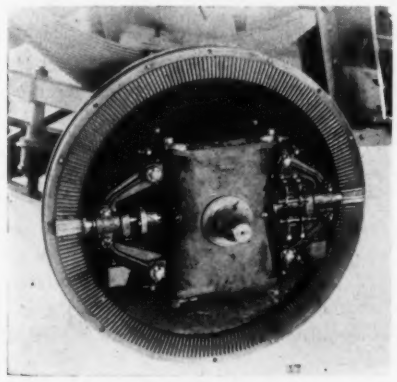


FIG. 2.—INTERIOR VIEW OF WHEEL MECHANISM.

of turns, some of the latter forming an arc of a 15-ft. radius. It follows in places a shelf of rock with a perpendicular wall on one side and a precipice 1,000 ft. in depth on the other, and with barely room for an 8-ft. roadway on the narrow ledge between.

Mr. G. W. Ritchey, superintendent of instrument construction, gave much study to the problem, and considered a large number of plans, all of which were disapproved as unsuited to the requirements. A heavy gasoline motor-driven truck was designed, but even this was not considered equal to the needs of the case. The building of a railway was also under consideration. Superintendent Ritchey finally decided upon the gasoline-electric, couple-geared automobile truck and the order was placed three months ago. The car is now completed and the final tests will be made and the truck shipped during the present month. The sum of

$25,000 is being expended in improving the mountain trail and making an 8-ft. roadway to the top of Mount Wilson.

The truck differs from others made by the manufacturers in that the storage battery which ordinarily supplies current to the four individual motors encased within the wheels is replaced with a dynamo directly connected to a 40-hp gasoline motor. These are placed in the forward part of the truck, and the controller mechanism governing the gasoline engine, dynamo and motors is placed in a position convenient to the driver's seat. The individual motors mounted within the wheels are of 4 hp each nominally, but designed for a heavy overload. These motors are so mounted that the shafts of the armatures are in a horizontal position, nearly at right angles with the axis of the wheels, but slightly at variance with their plane, and pinions at both ends of the shaft engage circular racks on both of the inner walls of the wheels. Torque is therefore applied from both ends of the armature shaft, forcing upward the rear and downward the front of the wheel when the vehicle is moving forward, forming a "couple" of forces and relieving all thrust from the wheel bearings.

The truck is provided with the steering gear that operates both front and rear wheels simultaneously, throwing the front and rear pairs at opposite but corresponding angles, and making the vehicle especially suitable for the short turns in the mountain roadway. On descending grades the motors in the wheels are converted into generators and act as a brake, regulation being secured through resistance provided for the purpose, and thus the wear and tear incidental to the use of mechanical brakes is eliminated, although such brakes are provided as auxiliaries.

The car is expected to operate on the steep grade of the roadway to the top of Mount Wilson at a speed of about two miles per hour when fully loaded, and is calculated to make about 12 miles per hour on the level.

The middle portion of the body of the truck is cut away to permit of the loading of the largest casting, that weighing five tons, and, in moving the telescope, each load carried will approximate that weight.

New Telephone Patents.

SWITCHBOARD CIRCUIT SYSTEMS.

There are probably as many possible and operative central-energy switchboard circuits as there are inventors, and as each manufacturing company is striving for improvement, the number of different circuit schemes, all embodying the same general principles, is legion. E. R. Corwin and H. G. Webster, both of Chicago, have both recently patented two-wire multiple-circuit systems. These merely vary the detail of retardation, relays and condensers to accomplish the necessary requirements of multiple switchboard operation. Mr. Webster has assigned his patent to the Kellogg Company and that of Mr. Corwin is assigned to the Monarch Telephone Manufacturing Company.

SUB-STATION APPARATUS.

E. E. Clement, of Washington, D. C., has patented a transmitter using a diaphragm which is so stiffened as to need no damping springs. The diaphragm is perforated at its center by a flanged opening, the flanges being turned in and thus stiffen the diaphragm. The microphone button is held in position against this flange by a spring, the button having an annular flange which rests against the edge of the diaphragm flange. The transmitter is of the inverted solid-back type, the button filling in the flanged aperture. The patent for this transmitter is assigned to the Dean Electric Company.

Another transmitter recently patented, the patent being assigned to the Western Electric Company, is the work of C. C. Gilchrest, of New York. In the transmitter a sheet metal bowl of the same diameter as the transmitter diaphragm is used. The flanged edge of the bowl is clamped to the transmitter, but insulated from it. One electrode is fastened to the center of the diaphragm and one to the opposing face of the cup. Surrounding these electrodes is a felt washer extending from cup to diaphragm, and thus making a closed space in which granular carbon is placed.

AUTOMATIC SYSTEM.

In Fig. 1 is shown a very simple circuit for an automatic system. A cumulative relay, *c*, controls the selective arm operating magnet *s*, while the unbalancing of a differential relay controls the ringing. The making of the line circuit operates the cumulative relay, *c*, and causes the returning pawl magnet, *d*, and the operating pawl magnet, *e*, to be energized. Now the latter *e* follows a series of quick breaks and makes, while *d* is slow and quick short breaks do not affect it. Thus quick breaks and makes advance and hold the switch arm. To ring, the user grounds

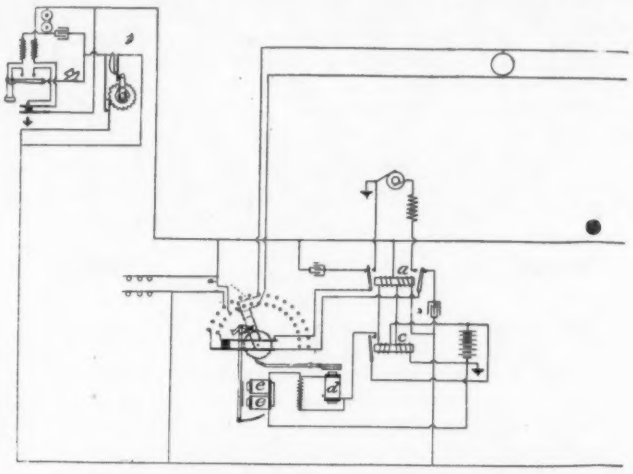


FIG. 1.—ENOCHS AUTOMATIC TELEPHONE EXCHANGE.

one limb of his line. This not only holds the cumulative relay, but unbalances the differential. The restorer of the apparatus of course follows a long break in the circuit.

C. D. Enochs is the patentee of this circuit, the Western Electric Company being assigned the patent.

EXCHANGE APPARATUS.

In Fig. 2 is shown a relay strip of novel sort in that the relays and strips are assembled after the manner of jacks in strips. The relay strip is formed to receive the relay coils and cores in bases provided for them, and it affords mountings for the armatures, terminals and contact springs. W. W. Dean is the in-

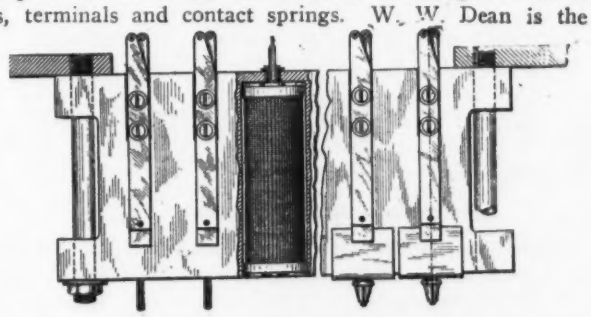


FIG. 2.—DEAN RELAY.

ventor, the Kellogg Company having been assigned the patent.

A. M. Hanbrich, of Chicago, has invented a simple form of jack marker associated with multiple jacks to afford information to the operators. Four holes are drilled in the mounting above each jack. These take the spindles of small colored tacks or other similar headed pins. The colors and locations together impart information desired to the calling operator. The Stromberg-Carlson Company has obtained this patent.

PARTY LINE RINGING SELECTIVE SYSTEM.

A patent has been granted to J. Z. Miller, of Erie, Pa., for a two-party selective system, both stations being rung by alternating current. At one station a high resistance coil is wired in series with the ringer and the two bridged across the line. For the other a retardation coil is bridged, the ringer being tapped off the neutral point of this to ground. For the latter station the two limbs of the line serve in parallel as one side of the ringing circuit and the earth for a return.

A. O. Stigberg, of Chicago, has invented a four-party system with selective ringing. Each station has two relays, one polarized and one non-polarized and sensitive to alternating currents. To operate a bell both relays must act in proper unison.

Thus, for station No. 1 alternating current on one side of the line actuates the alternating-current relay. This connects the polarized relay to the other limb of the line, where positive direct current operates it, thus connecting the ringer at station one to the alternating current of the first limb of the line. Station three's polarized relay was also connected in by the operation

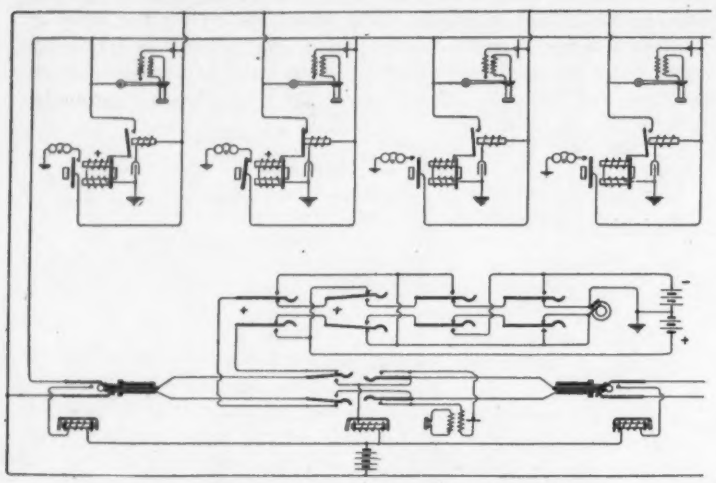


FIG. 3.—STIGBERG PARTY LINE EXCHANGE SYSTEM.

of its alternating-current relay, but this polarized relay being non-responsive to positive current, the ringer of three remained unconnected. Fig. 3 gives the circuits so that the other combinations may be studied out readily. The Stromberg-Carlson Company has been assigned this patent.

TOLL EXCHANGE CIRCUIT.

When the toll lines are connected together for a through connection, it frequently happens that an advantage arises if it be impossible to signal from one line through to the other. Such a case arises when one of the lines has several stations all checked by the switching station. In this case, unless an operator is particularly watchful, a line connected to this one may signal one after the other of the stations without the knowledge of the operator. In order to avoid this possibility, C. E. Scribner, of Chicago, has arranged his multi-station toll lines upon the switchboard so that it is impossible to ring through. This may be accomplished by wiring in a repeating coil of proper design. The switchboard is then provided with ringing keys which apply their current beyond the repeating coils. Mr. Scribner has patented this circuit and assigned the patent to the Western Electric Company.

RINGING CURRENT INTERRUPTER.

For years efforts have been made to design an interrupter and coil such that a low-powered battery may do satisfactory

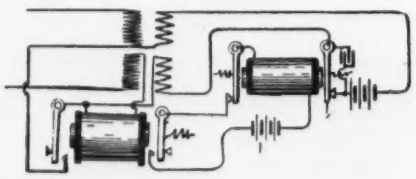


FIG. 4.—RUGH EXCHANGE SYSTEM.

ringing. In Fig. 4 is shown a circuit of a patent issued to H. O. Rugh, of Chicago, for such a scheme. The chief feature lies in the self-starting arrangement.

EXCHANGE APPARATUS.

A rather elaborate gang ringing and listening key forms the subject of a patent granted to E. B. Craft, of Chicago, and assigned by him to the Western Electric Company. This combines in one apparatus a listening key and a ringing key, with magnetic lock and release, for eight different ringing combinations. There are four spindles for the ringing part, each capable of slight rotation in either direction by means of a finger piece. The throwing of any spindle operates a master key to cut the ringing circuits into the line, and besides operates an individual switch to introduce upon the ringing circuit its own particular ringing current; at the same time it sets an indicator to show which was the last kind of ring sent out to provide for the contingency of response to the first call, and in addition locks all the spindles until the complete cycle of signals correspond with the spindle movement. Further than this the key when once thrown becomes locked, until it is released by the operation of a magnetic lock and trigger, which operates at some predetermined time. This key seems to reduce not only the number of contacts in the talking circuit to a minimum, but to provide for almost every contingency.

LETTERS TO THE EDITOR.

Graphic Representation of Induction Motor Phenomena.

To the Editors of Electrical World:

SIRS:—Being engaged recently in writing a dissertation upon polyphase induction motors, I was obliged to study various theories and diagrams. Among the articles read were the two of Dr. McAllister in the issues of ELECTRICAL WORLD of April 21 and May 26, and your remark of June 9, in which you write: "By boldly transgressing this rule and placing the leakage circuit across the outside mains Dr. McAllister has greatly simplified the problem, without incurring an excessive penalty of error." It is not at all my intention to reduce the value of the excellent articles of Dr. McAllister, but referring to your remark I must observe that an analogous simple circular diagram of the induction motor, as published by Dr. McAllister on May 26, was described by Mr. R. Goldschmidt in the *Electrotechnische Zeitschrift*, 1900, p. 693, and the deduction there is also based upon exact and simplified equivalent connections similar to those of Dr. McAllister. The whole difference between the two sorts of equivalent connections is, that Mr. Goldschmidt assumes less correctly the core loss resistance and the exciting reactance in series, which, however, has no influence upon the diagram itself. The equivalent connections for the induction motor were first given by Dr. Steinmetz.

DARMSTADT. EMIL DESCHAMPS.

To the Editors of Electrical World:

SIRS:—The writer wishes to express his thanks to Mr. Emil Deschamps for calling his attention to an article by Mr. R. Goldschmidt which appeared in *Elektrotechnische Zeitschrift* in 1900. The letter by Mr. Deschamps furnishes the first knowledge of the existence of such an article. As the files of the above-mentioned paper are not readily available, the statement in the letter that the article does in reality treat the simple circle diagram in a manner similar to that employed in the issues of the ELECTRICAL WORLD for April 21 and May 26, 1906, will be accepted as correct. A reference to the issue for April 21 will show that the article was not intended to bring forward any new theory, but merely to point out that the primary current of an induction motor "cannot be accurately represented by any circle howsoever located, even if the primary resistance were negligible, but that in any event the secondary current locus is a true circle." The article of May 26 dealt "specifically with the use of the simple circular locus of the primary and secondary currents of the motor for determining the complete performance of the machine." It would be folly for any one writing at the present date to claim originality with reference solely to the employment of the circular current locus of the induction motor or with reference to the representation of the electric and magnetic circuits of the general alternating-current transformer by equivalent electric circuits. The main facts connected with the above-mentioned treatments have been known to electrical engineers for many years.

NEW YORK. A. S. MCALLISTER.

Polyphase Magnets.

To the Editors of Electrical World:

Sirs:—In regard to Mr. Simon's criticism of my article on polyphase magnets, which appeared in your issue of July 21, it seems that Mr. Simon misunderstands the construction of the polyphase magnet in question, and the way in which the brass parts are applied. The main flux is not interlinked with the brass clamp rings, but the brass is applied in such a way as to act as a shield to prevent the straying of the magnetic flux, and it tends to force the flux in the right direction or from one pole straight over to the other. The pull is dependent not only upon the amount of the resultant flux, but, as clearly stated in my article, upon the concentration (proportional to B^2) and also upon the direction of the lines in regard to the desired motion of the movable armature. That the induced currents in the brass parts have a magnetizing effect in opposite direction to the stray fluxes is perfectly clear as the brass shields are parallel with the resultant flux which gives the pull, and also practically at right angles to the stray flux. The induced currents in these brass shields are, however, by no means non-inductive, as Mr. Simon states; but they lag very much behind the impressed e.m.f. The higher the conductivity of the brass parts, the more the induced currents lag, and the smaller the stray flux and the losses. With infinite conductivity of the brass part there would be theoretically no stray fluxes and no losses in these parts.

Mr. Simon's criticism seems to be somewhat inconsistent, as he first makes the statement that the induced currents in the brass parts are non-inductive; then later he talks about "a secondary stray field" which is interlinked with the secondary circuit. If the secondary circuit has a stray field it should be evident that the secondary circuit must be inductive.

I fail to see how Mr. Simon can state that I propose to increase the total primary flux by means of the brass shields, or that the main primary flux produces the useful pull. The brass shields cannot possibly increase the main primary flux, the value of which depends only upon the impressed e.m.f., but they do concentrate, direct, and increase the flux that produces the useful pull.

The fact that, as Mr. Simon states, a decrease in the primary turns (which is the same as an increase in the flux) increases the pull is already treated in my article and requires, therefore, no additional comments.

Yonkers, N. Y. D. L. Lindquist.

DIGEST OF CURRE NT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Thermo-Electric Generators.—Heil.—An illustrated paper read before the Karlsruhe Electrical Society. In order to make thermo-cells practical, their internal resistance must be low, and the joints must be made in such a way that the transition resistance does not increase with time as is generally the case in ordinary thermo-cells. The author describes various improvements made by him in soldering the joints, and in the whole construction of the apparatus, the different cells being arranged by him around a cylinder, with their hot joints on the surface of the cylinder, the cylinder to be heated from the inside by means of gas, kerosene, or coal, etc. He states that with such apparatus one kw-hour may be produced for about 12.5 c. It is said that the Guelcher thermo-cell consumes 48 liters of illuminating gas per watt-hour, while the author's apparatus requires only 15 to 20 liters. An apparatus operated with coal is said to give about 50 watt-hours per kilogram of coal. Such thermo-cells may be used to advantage for utilizing the heat in exhaust gases, for instance on automobiles. The energy thus produced is stored in a battery which supplies current for the ignition of the engines, and perhaps for lighting. The thermo-cells do not derive any power from the engines, but only from the exhaust gases which heretofore were passed off into the air.—*Elek. Zeit.*, October 4.

High-Speed Electrical Machinery.—S. P. Thompson.—The first parts of a series of Howard lectures delivered before the London Society of Arts, on high-speed electrical machinery with special reference to steam turbines. In the first lecture the author discusses the problem of electrical design as affected by speed and rated output; in the second lecture he deals specially with direct-current generators. The serial is to be continued.—Lond. *Elec., Eng.*, September 28 and October 5.

Three-Phase Currents.—Niethammer.—The first parts of an illustrated serial on the general diagram of three-phase currents and its application to all kinds of three-phase machinery.—*L'Eclairage Elec.*, September 29 and October 6.

Power.

Generation of Electricity in Mines.—Baum.—A long serial in which the author first discusses the general situation of generation of electrical energy with special reference to recent progress made in gas engines and steam turbines. While some smaller water powers have recently been developed in Germany, no larger water powers are available in that country. The following figures are given as to the cost of developing several profitable water powers in Europe; At St. Michel-en-Maurienne in France (with a plant capacity of 4,000 hp) the cost of development was $44 per hp; at Haute Rive, Switzerland (including canal 5½ miles in length, with a plant capacity of 5,000 hp), first cost was $120 per hp; at Manslow, Sweden (5,000 hp), $152 per hp; at La Praz, France (13,000 hp), $42.50 per hp; Rheinfelden, Switzerland (17,000 hp), $47 per hp; at Loch Ericht in Scotland (38,000 hp), $160 per hp. The cost of development depends greatly on the height of the falls. With large heights the cost for the hydraulic development may be reduced to $40 per hp. In Germany it is proposed to erect electric central stations at coal mines and to utilize cheap grades of coal, which could not be profitably sold otherwise. The plants would deliver power for the mines in the morning and during the day, while in the evening when energy is consumed mainly for lighting, only the ventilators, air compressors and pumps would be operated in the mines. The most remarkable example of a central station in a mining district is the Rhenish-Westfalian Electricity Works in Essen, which supplies energy to the city of Essen and to a large number of villages, railroad stations, etc., and also furnishes the whole energy for a number of mines and metallurgical plants like Krupp. The mines get energy from the station mainly between 6 o'clock in the morning and 2 o'clock in the afternoon. In those hours in which the lighting load of the station is a maximum, namely 3:30 to 8 in the afternoon, no current is furnished to the mines, but the mines are permitted to supply energy from their own private plants to the network of the main station. The advantages of this arrangement are that the private plant of each mine need only be dimensioned to supply the average load, since all the surplus energy is furnished by the main station; further, no reserve is necessary. Since the private stations may supply energy to the main network, a uniform and economical load is rendered possible. On the other hand, the main power transmission station has such an enormous load during the whole day that very large economical units may be installed; the power plant is, of course, located directly at the coal mine. While the cost of generating power at this works is not given, it is said that it must be very low, since several years ago when the generating sets were not yet as perfect as at present, and when the sale of energy was much less than now, the power plant made an agreement with the city of Muelheim to furnish energy for 25 years at a cost of 2.18 cent per kw-hour for traction, 3 cent per kw-hour for power purposes, and 3⅜ cent per kw-hour for lighting. These prices are far below the cost of generating energy in a great number of large municipal German central stations. A similar large power transmission plant will be erected in Westfalia.—*Glückauf*, August 4, 11, 18 and September 1.

Traction.

Three-Phase Mountain Road.—Herzog.—A fully illustrated description of the three-phase mountain road from Brunnen on the Vierwaldstätter Lake in Switzerland, to Morsebach. The

total length of the line is a little over two kilometers, of which about one-half is straight road, the other half curves. The average grade is 14.5 per cent; the maximum grade 17 per cent. It is a rack and pinion road, being supplied with three-phase current at 8,000 volts, the frequency being 50, from a power station. In a sub-station containing four 75 kilovolt-ampere transformers, the voltage is reduced to 750. Two trolley wires are suspended above the road. Each locomotive contains two 85-hp, three-phase motors, and weighs 10,500 kilograms. On the maximum grade of 17 per cent it is able to haul a load of 15,500 kg at a speed of 9 km per hour.—*Elek. Bahnen*, August 24, September 14 and 24.

Surface Contact System.—Schwerak.—An illustrated description of the Krizik surface contact system used on the Karls Bridge in Prague. Two metallic contacts are provided between the rails, one being used for supplying the main current to the car motors, while the other is an auxiliary contact operated in connection with the batteries actuating the relays. By means of the latter auxiliary contact an electromagnetic device is actuated which completes the circuit for the main current supplied through the other contact. The main contacts are alive only at the instant when they are passed by a car. To prevent any possibility of a contact remaining live after the passage of the car, a brush is carried on the back of the car, which when touching the contact causes a short circuit, and a fuse in the relay box is blown.—*Elek. Bahnen.*, August 4.

High-Voltage Direct-Current Road.—Rinkel.—A very long and fully illustrated description of the interurban road between Cologne and Bonn along the river Rhine, the special feature being the use of 1,000-volt direct-current motors, as has already been noticed in the Digest.—*Elek. Bahnen*, September 4, 14, 24 and October 4.

British Tramway Account.—An abstract of the annual report of the Municipal tramway station at Oldham, which showed last year a surplus, after having shown a deficit before. The total electrical energy used for traction, lighting of cars, depots and workshops, and for motors in the workshops was 3,089,133 kw-hours, the average kw-hours consumed per car mile being 1.76. The total working expenses per car mile, excluding capital charges, were 14.290 cents, and, including capital charges, 21.956 cents.—Lond. *Elec.*, October 5.

Brakes.—Sayers.—A continuation of his serial on brakes for tramway cars, dealing especially with different types of wheel brakes.—Lond. *Elec.*, October 5.

Installations, Systems and Appliances.

High-Voltage and High-Frequency Oscillations in Direct-Current Networks.—Feldmann and Herzog.—The conclusion of their mathematical paper, the first part of which was recently abstracted in the Digest. The authors discuss the corrections due to the non-uniform distribution of the current over the cross-section and give the complete theory according to Heaviside. In standard 500-volt direct-current cables with return through the lead cover, the maximum voltage of the oscillations which may be set up will be 8 to 20 volts for one ampere of short circuit current, the frequency being 15,000 to 21,000 periods per second. When cables are connected with overhead lines or when overhead lines are used alone, greater over-voltages may be produced. These oscillations produce injurious effects only in rare cases on account of their quick extinction, the small power involved and the favorable effects of damping. Nevertheless it is to be recommended to connect the lead covers of the different cables carefully together and to connect them to earth at suitable places.—*Elek. Zeit.*, October 4.

Wires, Wiring and Conduits.

Cost of Cables.—Hobart.—A long article on the factors controlling the cost of cables. From statistical data of British stations it appears that the capital invested in transmission lines and cables is somewhat like one-third of the aggregate capital invested in electric plants. Some data are given on the insulation used by different American companies on three-conductor high-tension cables, and from this data the following table is derived:

Line voltage	Thickness of insulation in millimeters per 1,000 volts. Bet. conductors	Bet. conductors and ground.
6,600 to 9,000 (say 7,000)	1.33	1.16
11,000 to 12,500 (say 11,500)	1.08	0.85
15,000	0.84	0.74
25,000	0.52	0.42

From a consideration of these figures, and from the fact that

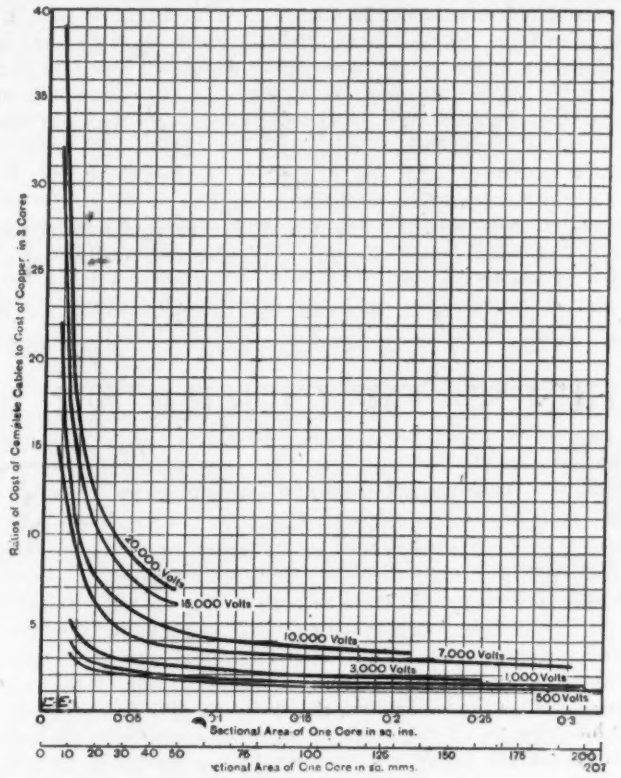

Ratios of Cost of Complete Cables to Cost of Copper in 3 Cores
20,000 Volts
15,000 Volts
10,000 Volts
7,000 Volts
3,000 Volts
1,000 Volts
500 Volts
Sectional Area of One Core in sq. ins.
Sectional Area of One Core in sq. mms.

FIG. 1.—COST OF CABLES.

the disruptive strength per unit of thickness of insulation decreases with increasing thickness of insulation, it is evident that the higher the rated voltage of cables designed in accordance with the proportions given in the above table, the lower

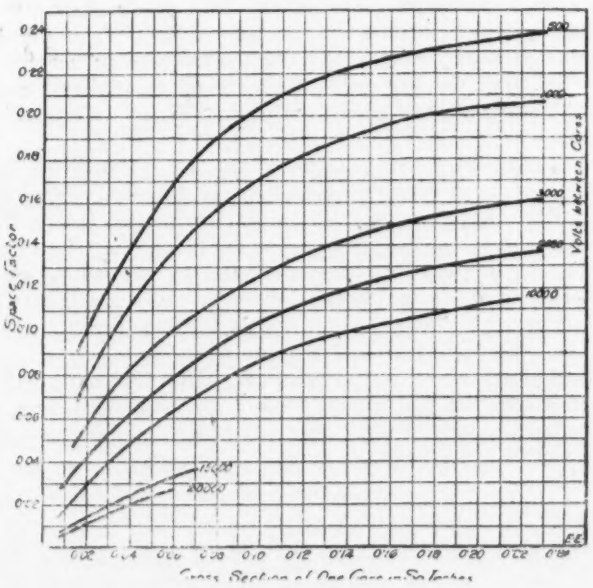


FIG. 2.—COST OF CABLES.

will be the ratio of testing voltage to normal working voltage, which can be guaranteed. The practice of permitting a decrease in the specific thickness of the insulation with increasing normal pressure is not technically sound, and it is only the result of the force of circumstances. Were the same factor of safety

employed in 25,000-volt as in 5,000-volt cables, the thickness of insulation would have to be considerably increased for 25,000-volt cables, and their cost would be prohibitive. Were this relation more generally known, there would be a still more pronounced tendency to keep down toward 11,000 volts as the present economic pressure for underground transmission lines. The chief components of the cost of cables are the copper, the insulation, the lead, and the installation of the cable. On the assumption that the cables are installed in tunnels on underground railroads, etc., and that no charge is made to the cable department for the construction of the subways, the author gives extended tables of dimensions, weight and cost for three-core lead-covered high-tension cables with voltages varying between 1,000 and 20,000. The cost of copper is taken as $500 per ton, this being the cost of the copper core, as stranded, including charges due to wire-drawing and stranding. Fig. 1 gives curves showing the ratio of the cost of the complete cable to the cost of the contained copper for various voltages and cross-section of core. These curves show very clearly that the cost of copper in high-tension cables is but a very small percentage of the total cost of the cables. Other curves are then given showing the cost of cables at various voltages for transmission over different distances and at different power factors. These curves bring clearly out the fact that while in regions like the western districts of America it is of distinct advantage to use extremely high potentials for overhead lines with bare conductors, much lower pressures will give the most economical results where underground cables are required by the regulations of the authorities. In all the curves the cost is given as the ordinate and the transmission voltage as abscissa, and the minimum point of the curve therefore corresponds to the most economical transmission voltage. At voltages higher than this, the cost of the insulation exercises a preponderating influence, and at lower voltages the cost of the copper, thus rendering the complete cable more expensive at pressures higher and lower than that for minimum cost. The author then defines the space factor of a cable as the ratio of the total section of copper in the cable, to the section of the complete cable, not including the lead. Curves showing the relation between the space factor of high-tension cables and the sectional area of the core for various voltages between cores are given in Fig. 2.—Lond. *Elec. Eng.*, September 14, 21 and 28.

Electro-Physics and Magnetism.

Disruptive Voltage of Thin Liquid Films.—SHAW.—An account of an experimental investigation in which the author studied the disruptive voltage of thin liquid oil films between iridio-platinum electrodes. The potential difference varied from 25 to 400 volts, and the corresponding spark lengths from .1 micron to about 10 microns (1 micron equals 0.001 mm.). The temperature was between 15° and 18° C. Various types of vegetable, animal and mineral oils, as well as varnishes, were tested. The chief results are summed up as follows: The insulating liquids do not differ very much from one another in power of resisting discharge, the strength lying between the limits 110 volts per micron and 70 volts per micron, though some liquids seem to have slightly less strength. Some liquids have a peculiar variation in potential gradient for distances between 1 and 2 microns. Castor oil, olive oil and paraffin are cases in point. All insulating liquids have greater strength than air for potential differences greater than 300 volts; for small potential differences liquids have much less strength than air. The results for a homologous series of hydrocarbons do not indicate any simple connection between composition and power of resisting discharge; the differences found are as likely to be due to accidental impurities as to specific qualities of the liquids. But these simple substances have specially great dielectric strength. It may be that simplicity of composition makes for strength. Whereas in the cases of gases there is always a horizontal portion in the curve, in liquids there is no such distinct break in the curve between 25 and 400 volts, unless the region at about 60 volts in castor oil, olive oil and paraffin is of this nature. No simple connection can be observed between power of resisting discharge and specific inductive capacity in liquids.—*Phil. Mag.*, October.

Reflection and Transmission of Electric Waves.—BLAKE AND FOUNTAIN.—An account of an experimental investigation of the reflection and transmission of electric waves by screens of resonators and by grids. The chief results are as follows: For a system of linear resonators, the length for maximum resonance is, within fairly wide limits, independent of the distance apart of resonators in the direction parallel to the electric force but varies in an inverse manner with the distance between resonators in a direction perpendicular to the electric force. The mutual influence between resonators at side-on distances greater than a wave-length of the incident radiation ceases to affect the length for maximum resonance appreciably. The resonator length for maximum resonance depends upon the dielectric properties of the plate to which the resonators are attached. Secondary resonance maxima occur only at odd multiples of the fundamental resonating length. Neither the Hertz-Poincaré nor the MacDonald ratio for the quotient of wave-length by resonator length holds for a uniform linear resonator. Certain systems made up of resonators of lengths differing with the distribution over the surface of a glass plate, transmit more energy than the same glass plate when bare, and a simple and general explanation of this result is afforded by the theory of optical dispersion. It is possible to increase the reflection from a grid of very long strips any distance apart by cutting them up into lengths equal to the resonance length for that distance. The distance apart of fine wires in a grid to be perfectly opaque to electric waves of length l when the wires are parallel to the electric force, should be of the order $4 \times \frac{l}{40}$. When at a distance $\frac{4}{5} l$ apart, the same wires transmit practically all of the incident radiation.—*Phys. Rev.*, October.

Recombination of Ions.—KLEEMAN.—An account of an experimental investigation of the recombination of ions made by alpha, beta, gamma or Roentgen rays. The chief results are as follows: The lack of saturation with weak ionization by alpha rays is not due to diffusion of ions, nor does it depend on the recombination coefficient or velocity of the ions. Initial recombination is very small in gases ionized by beta, gamma or Roentgen rays; in other words, these ionizing agents effect a complete separation of the negative ions from their parent molecules. This appears to be related to the fact that the secondary cathode rays from a metal plate on which beta, gamma or Röntgen rays fall have considerable penetrating power, while no such penetrating cathode rays have been shown to exist in the case of the alpha particle, and it seems reasonable to conclude, from this and other facts, that the velocities of the electrons ejected from molecules in the gaseous state ionized by beta, gamma or Roentgen rays are of the same order, while the velocity of an electron ejected by an alpha particle is much smaller. This property of the beta rays is not destroyed by passing them through a thick aluminum plate. The initial recombination observed when a gas is simultaneously ionized by alpha and gamma rays is equal to their separate effects. Initial recombination is greater the slower the velocity of the ionizing alpha particle, which probably means that the slower the velocity of the alpha particle the slower the velocity of the ejected electrons.—*Phil. Mag.*, October.

Radio Activity.—RUTHERFORD, HAHN, CROWTHER, MOORE AND SCHLUNDT.—Rutherford presents a paper on the mass and velocity of the alpha particles expelled from some of the particles of radium and actinium. The chief conclusion from his and Hahn's experiments is that the alpha particles emitted from the various products of radium have an identical mass and differ only in the initial velocities of projection. He thinks it is reasonable to conclude that the alpha particles expelled from the different radio elements have the same mass in all cases. This is important, for it shows that the uranium, thorium, radium and actinium which behave chemically as distinct elements, have a common product of transformation. The alpha particle constitutes one of the fundamental units of matter, of which the atoms of these elements are built up. He thinks that either the alpha particle is a helium atom carrying twice the ionic charge of hydrogen, or is half of a helium atom carrying a single ionic charge. A paper by Crowther deals with the coefficient of absorption of the beta rays from uranium. A paper by Moore and

Schlundt with some new methods for separating uranium X from uranium.—*Phil. Mag.*, October.

Temperature Gradient in Common Materials.—Thwing.—Since the radioactivity of radium compound produces an elevation of temperature within the mass of the substance, it is to be expected that other radioactive bodies will exhibit the same phenomena in a smaller degree. Since many metals and common materials have been found to be radioactive, the author suspected a temperature gradient within the same, and the experiments described by him seem to show that the magnitude of the temperature gradient in common metals and rocks, is large enough to be detected and measured.—*Phys. Rev.*, October.

Roentgen Rays.—Koch, Walter and Jirota.—Some letters on the present status of Roentgen ray apparatus and on the use of alternating currents for Roentgen ray purposes.—*Elek. Zeit.*, October 4.

Iodine Vapor.—Wood.—An account of an experimental investigation of the fluorescence, magnetic rotation and temperature emission spectra of iodine vapor.—*Phil. Mag.*, October.

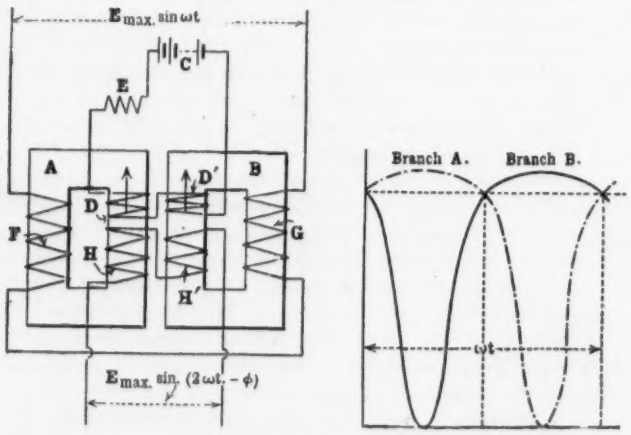
Ultra-Violet Light.—Ramsay and Spencer.—A paper on the chemical and electrical changes induced by ultra-violet light. The authors first give some speculations on the electronic theory and especially on the manner in which they think that electrons are capable of associating themselves with matter. They describe various experiments on the effect of ultra-violet light, especially on the discharge of charged surfaces, on the e.m.f. produced in a cell with two equal electrodes, one of which is subjected to ultra-violet light, while the other is protected, etc.—*Phil. Mag.*, October.

Electro-Chemistry and Batteries.

Electrochemical Laboratory.—Some notes on the new Muspratt Laboratory of Physical and Electrical Chemistry at Liverpool University.—Lond. *Elec. Rev.*, October 5.

Units, Measurements and Instruments

Static Frequency Transformer.—Leonard and Weber.—An illustrated note on the application of asymmetric magnetization to alternating-current apparatus, for instance, for the construction of a static frequency transformer. The arrangement of apparatus is represented in Fig. 3. *A* and *B* are the cores of two transformers, whose primaries, *F* and *G*, are connected in series. The secondaries, *H* and *H'*, are also connected in series. In addition to these windings, the transformers are provided with the windings, *D* and *D'*, connected in series with the reactance coil, *E* (which is intended to suppress fluctuations in the current due to



FIGS. 3 AND 4.—STATIC FREQUENCY TRANSFORMER.

the alternating e.m.f's induced in *D* and *D'*), and supplied with continuous current from the battery, *C*. The windings, *D* and *D'*, are so arranged relatively to *F* and *G* that during the half-period when *D* and *F* assist one another, *D'* and *G* oppose each other. The continuous current is chosen so that the m.m.f. due to it is sufficient to produce saturation. If the alternating currents in *F* and *G* be such that their maximum m.m.f. is equal to twice that of *D* or *D'*, the fluxes through *A* and *B* will be as indicated by the full-line and chain-dotted curves of Fig. 4, the change of flux in either core during addition of the m.m.f's being very small, owing to the fact that the core is already saturated by the continuous current, while, on the other hand, the change of flux during opposition of the m.m.f's is relatively very large. By adding the ordinates of the two curves, we obtain a resultant curve which represents the algebraical sum of the fluxes through *H* and *H'*. This is easily seen to be a periodic curve whose period is half that of the alternating current in either primary, so that the resultant alternating e.m.f. in *H* and *H'* will have twice the frequency of the primary currents.—Lond. *Elec.*, October 5.

Telegraphy, Telephone and Signals.

Telegraphy.—Devauz-Charbonnel.—An account of an experimental investigation of telegraphic transmission with the aid of Blondel's oscillograph. The wave front is propagated with the speed indicated by theory. Denoting by *C* and *L* the capacity and inductance per unit length respectively this speed is $V = 1 \div \sqrt{CL}$. From the experimental values he obtained:

	Copper lines.	Iron lines.
C	0.009 mf. per kilometer....	0.009 mf. per kilometer.
L	0.002 henry per kilometer..	0.006 henry. per kilometer.
V	236,000 km. per second.....	136,000 km. per second.

This speed is that given by experiment. When the wave arrives at the receiving station there exists a variable condition for a certain period of time. In a line without apparatus the variable period appears to be terminated at the time $\sqrt{CL}$. This period of time is different for a line with apparatus. Locally on a circuit comprising only a cell and an apparatus, the permanent state of conditions is practically obtained by the time $4L_1 \div R_1$, where R_1 and L_1 are the resistance and inductance of the apparatus respectively. When the apparatus is connected with an aerial line, this time is considerably reduced and is represented by the empirical formula $\sqrt{CL} + (3L_1) \div (4R_1)$. This formula has been verified for lines composed of aerial sections 120 to 600 miles in length, comprising an underground section at each end, 4 to 5 miles long, and coupled to Morse and Baudot instruments. In order to be correctly received, the signals must succeed each other at intervals such that the variable period corresponding to one of them is over before the next appears. The period of time of variable conditions for which the formulæ were given above, therefore, practically represents the shortest duration which can be given to any signal, and it therefore measures the maximum speed of transmission.—*Comptes Rendus*, July 23; Lond. *Elec.*, October 5.

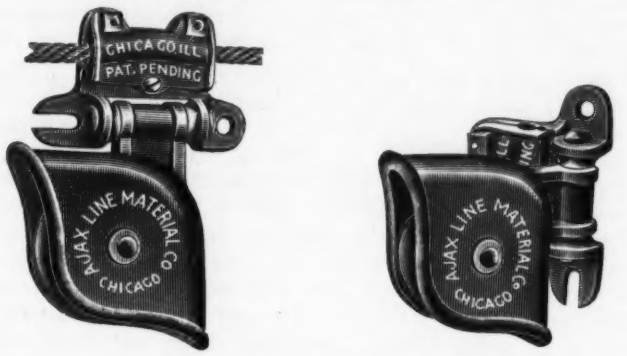
Wireless Telegraphy.—Solff.—A fully illustrated description of the latest equipment of wireless telegraphy stations operating by the Telefunken system. These stations are intended to be used for transmission over distances from 60 to 300 miles, and in special cases also up to 600 miles over sea. The author describes in detail the arrangement of the vertical wire, and the connections in the transmitting and receiving stations, and then describes the stations at Scheveningen in Holland, the Batavia-Cheribon station in Asia, and the Mariel-Pinos station in Cuba. *Elek. Zeit.*, September 20.

Miscellaneous.

Electrical Signs of Life.—Waller.—An abstract of a lecture held before the British Association on the electrical signs of life which the author has studied in recent years. All mechanical and chemical changes in living organisms, he said, were accompanied by electrical changes which were the signs and measure of vital action. When an animal died, its members did not die at once, and we could hence experiment on nerves, muscles, an eyeball, a flower petal, a green leaf, a vegetable seed. The muscle could respond only mechanically, the nerve electrically. The effects of anæsthetics were very marked. The normally living response to an excitation of the nerve, which the author calls a "blaze current" because he first observed the effect when a retina was excited by light, was modified, or temporarily or permanently arrested. With alcohol, especially when impure with fusel oil, a distinct period of intoxication could be observed; either was only about an eighth as strong as chloroform, which yet ought to be a safe anæsthetic in concentrations of 2 per cent. The effects of carbon dioxide and of a stimulus by light were also demonstrated.—Lond. *Eng'ing*, September 14.

Sleetproof Pulley.

With the extension of arc lighting for mills, factories and all kinds of outdoor lighting, the methods of supporting the lamps vary greatly even when the lamps are to be hung from a hoisting rope. To meet these manifold conditions, the Ajax Line Material Co. is bringing out the new "Universal" pulley pictured herewith in Figs. 1 and 2. This is a sleetproof pulley swiveled from an ingenious clamping plate, which readily grips



FIGS. 1 AND 2.—UNIVERSAL PULLEY.

any of the commonly used sizes of suspension strand. The clamp also has ears allowing it to be bolted to either a round or a square pole, to a wall, a beam or a ceiling. As this practically covers the ordinary range of pulley supports, the new type fills a decided need. It is made by the Ajax Line Material Co., of Chicago.

Innovations in Attachment Plugs.

An innovation in attachment plugs is that recently placed upon the market by the Sarco Company, 906 Sixth Avenue, New York, which it terms the "Sarco swivel, separable, attachment plug." In addition to being separable, it is also swivel and at the same time will pull apart at any angle. The accompanying illustrations (Figs. 1 and 2) show the plug open and closed.

By an ingenious locking device in the bottom part of the plug

FIGS. 1 AND 2.—PLUG OPEN AND CLOSED.

the top part is gripped firmly and at the same time has a ball bearing and revolving contact. The heavy circular band in the top plug makes contact with two heavy phosphor-bronze spring contacts in the bottom plug, making one pole, while the center stud in the top plug locks into the center of the bottom plug, thereby giving more contact surface to this plug than is found in the ordinary separable plug. Should the cord attached to the plug become twisted, it is not necessary to separate the plug, but simply revolve the top part, as it swivels in either direction; and yet at the same time should the cord attached receive an accidental blow or strain, the top part would become separated from the bottom part, thereby automatically disconnecting the circuit.

In addition to its advantages for heating apparatus, motors, massage apparatus, etc., on account of its heavy carrying capacity, it is very advantageous for physicians' appliances, X-ray machines, charging of storage batteries, etc., as the poles cannot become reversed in the top part of the plug, the center stud always fitting one pole and the outside band connection fitting the other. It has plenty of room inside of the top part for a knot in the cord and will take any size of the standard reinforced cord.

Exhibits at the American Street Railway Convention, Columbus, Ohio.

THE ELECTRIC SERVICE SUPPLY COMPANY, Philadelphia, had an exhibit which attracted general attention by reason of its comprehensiveness and tasteful disposition, and the facilities provided in the office for the comfort of visitors. Practically every class of supplies used in the construction and operation of electric railways was represented. Among representatives of the company present were: Charles J. Mayer, president; A. H. Englund, treasurer; J. W. Porter, first vice-president; Max A. Berg, secretary; J. V. E. Titus, second vice-president; G. W. Cox, Keokuk office; H. G. Lewis, Philadelphia office; John McSorley, Philadelphia office; William A. Armstrong, Philadelphia office; F. B. Massey, Philadelphia office; Benjamin Hayller, Jr., Philadelphia office; Robert Montgomery, Philadelphia office; James Stewart, Philadelphia office; E. R. Mason, Chicago office; John M. Gallagher, Chicago office; W. P. Cosper, Chicago office; Edward Hammett, Pittsburg office; Henry R. Swarley, Jr., New York office; C. E. Watts, Atlanta office; Ernest Boehme, St. Louis office; H. L. Adams, Chicago office; Joseph B. Noros, Philadelphia office; C. H. Bristol, Chicago office, and S. F. Alden, San Francisco office.

THE STERLING VARNISH COMPANY, of Pittsburg, were represented by S. C. Schenck, W. V. Whitfield, C. L. Cool, A. S. King and Charles A. Baker, to talk insulating compounds. The exhibit of the company was in Building No. 1.

THE RAIL JOINT COMPANY, of New York, had an extensive exhibit in an attractively decorated space in Building 2. Some fifty sections of rails were shown fitted with joints in different parts of the exhibit. The representatives of the company were James C. Barr, of Boston; Benjamin M. Barr, of New York; G. A. Hagar and D. J. Evans, of Chicago; E. A. Condit, Jr., of Pittsburg; H. C. Holloway, of Cincinnati; J. G. Miller and C. E. Irwin, of St. Louis.

THE NATIONAL CARBON COMPANY, of Cleveland, Ohio, had a complete display of carbon brushes for street railway motors and carbons for arc headlights. N. C. Cotabish, sales manager; F. D. Kathe, A. G. Cummerell and J. F. Kerlin represented the company.

THE LORD ELECTRIC COMPANY, of Boston, exhibited Shaw non-arcing lightning arresters and various types of the Thomas soldered rail bond. The method of applying the bonds was shown by means of short sections of rails with the joints bonded. Torches for heating the bonds and clamps used in applying them were also exhibited. The exhibit was made in connection with that of the W. R. Garton Company, which is the representative of the Lord Electric Company in the Middle West. G. B. Crane and E. M. Hamlin represented the company.

THE ALLIS-CHALMERS COMPANY occupied 1,400 sq. ft. of space which had been decorated throughout in green and black, with mission style of furniture, and the railings painted a color to match. Palms and cut flowers were also used to give greater attractiveness to the booth. On the walls were hung large framed pictures, illustrating the various types of machinery manufactured by the Allis-Chalmers Company, such as steam turbines, reciprocating steam engines, gas engines, hydraulic turbines, condensers, boiler feed pumps, electrical apparatus of various kinds, rock breakers for ballast plants, etc. The exhibit proper consisted of the apparatus used by street railway systems, prominent

among which were two Allis-Chalmers railway motors, one of 50 hp and the other of 75 hp, together with controller and resistance grids; a complete line of Christensen air brake apparatus, now manufactured solely by the Allis-Chalmers Company; stationary and movable blading from an Allis-Chalmers steam turbine; Allis-Chalmers power transformers, both assembled and in various stages of construction; Allis-Chalmers induction motors, potential starters, etc. The exhibit was in charge of C. A. Tupper. Other representatives of the company present were F. C. Randall, W. W. Power, J. H. Denton, W. S. Doran, G. B. Foster, W. T. McCaskey, A. N. Libby, W. S. Heger, O. A. Stranahan, H. A. Strauss, M. W. Thomas, George Voigt, H. S. Buell, F. C. Colwell, C. E. Lord, W. J. Buckley, W. H. Powell, Ervin Dryer, Fred. L. Webster, J. W. Murray, J. W. Gardner, A. Brodock, B. A. Behrend, Louis Bogen, E. Mattman, David Hall, W. B. Spellmire, W. J. Richards, W. D. Pomeroy, B. Ellshoff and Lea Nicholson.

The Electric Storage Battery Company, Philadelphia, Pa., had a very complete exhibit in building No. 1. One of the most attractive features of this display was composed of two type-R cells. One of these represented the type contracted for by the New York Central & Hudson River Railroad, which will use 60,000 hp in its eight sub-stations. The other cell showed the style adopted by the New York, Long Island & Pennsylvania Railroad Company, which will install a total capacity of 4,000 kw. In the space were also shown carbon regulators, hydrometers of various kinds, sample plates, load curves, photographs and maps showing the wide distribution of its plants. The exhibit was in charge of Messrs. G. H. Atkin, H. B. Gay, R. C. Hull and H. H. Seamon.

The Joseph Dixon Crucible Company, Jersey City, N. J., had in the center of its space a large paint can to which visitors were admitted and the interior proved to be a laughing gallery with distorting mirrors. Lady visitors were given souvenirs consisting of miniature paint pails containing thimbles and the men received dice boxes. The actual exhibit consisted of graphite specialties, including the company's graphite silica paint for metal protection, belt dressing, graphite brushes, crucibles, bearing greases, etc. The representatives in attendance were C. H. Spatts and L. H. Schneider, of Jersey City, and F. R. Brandon, of Chicago.

The Gould Storage Battery Company, New York, was represented by R. H. Watson, of Chicago; H. W. Powers, manager of the telephone department; John Eipper, manager of the maintenance department, and Taliaferro Milton, of Chicago. The exhibit consisted of a number of single cells of batteries for railroad and lighting work, including a 49-plate, type U lead-lined tank of 720 amp. at eight-hour discharge; a 19-plate, type S lead-lined battery of 180 amp. for eight hours, and a 21-plate, type O cell having a capacity of 100 amp. for eight hours. A large number of photographs of Gould installations were shown, including one of a plant of 280 cells with a capacity of 640 amp. for one hour, which was recently erected at Topeka, Kan.

The Sprague Electric Company, New York, extended a cordial welcome through Mr. W. A. Treat, of Chicago. Its exhibit consisted of sections of its flexible steel-armored hose. This hose is widely used for steam or compressed air. It has been found very serviceable in such severe work as steam drilling and also in connection with compressed air tools.

The Watson-Stillman Company, New York, had its exhibit in charge of Mr. Edward A. Johnson, who explained the merits of the wide variety of hydraulic tools made by this company.

The Franklin Electric Manufacturing Company, Hartford, Conn., was represented by P. S. Klees, C. Leonard, G. O. Curtis and F. E. Wilson. It showed especially its new vibration-proof lamp for street railway service. This lamp has a filament anchored at its lowest point and supported direct from the stem, this being secured by the use of a small glass column extending from the stem past the upper portions of the filament coil. The filament is fastened to an anchor wire welded in the glass columns. Some interesting experiments were conducted showing the excessive vibrations to which lamps of this kind could be safely subjected. There was also shown a reflecting back for a lamp which it is claimed will reflect 125 cp from a 50-cp lamp.

The Western Electric Company, Chicago, Ill., was well represented by R. H. Harper and F. D. Killion, of New York; W. Burrows, W. L. Stockton, H. Walton Heegstra, W. F. Sandwell, G. C. Guest and A. S. Howlett. It showed a great number of photographs of power and railway generators. Also samples of Deltabeston field and armature coils, arc lamps and railway materials.

The D. & W. Fuse Company, Providence, R. I., had an exhibit in charge of W. S. Sisson and C. E. Harmann. It showed a great many varieties of its cartridge fuses, enclosed fuse cut-outs and boxes. Prominent among these was a high-tension, 2,500-volt, 60-amp. overhead box, a transformer cut-out designed for 30 amp. and a new code 100-amp. railway box.

The Dearborn Drug & Chemical Company, Chicago, Ill., had, as usual, a space which was always well filled with callers. Its reception committee consisted of G. W. Spear, R. F. Carr, Daniel Delaney, A. W. Clark and P. F. Payne. It had its boiler feed compounds and lubricating oils very tastefully arranged and distributed some attractive printed matter.

The Southern Exchange Company, New York, had an exhibit which was most attractive. On either side of the entrance were octagonal and square poles with cross arms of long leaf yellow pine. There were also displayed sections of Southern white cedar poles, Georgia pine cross arms and birch pins. E. J. Chamberlain, president, and Walter Mitchell, sales manager of the company, were present. They reported that business for the past few months had increased enormously and that they were doing a great deal of work among street and interurban roads in Southern pine poles, ties and pins.

The John A. Roebling's Sons Co., Trenton, N. J., had an exhibit which gave some idea of the breadth of its interests. It showed numerous samples of armature coils, field coils, rail bonds and car cables. The Roebling solder bond, which has recently been introduced, is tinned in a strip before being formed and there are corrugated solder boxes on the contact surface to insure the contact being perfect. It also showed several varieties of grinders for bond work, including one of the wheelbarrow type, which can be handled by one man; a velocipede grinder, a ball bearing grinder and an outfit fitted with a 1½-hp gasoline engine. In the electrification of the New York Central Railroad twenty of these are now in service and they are designed particularly for this class of work. Samples of 500,000-cir.-mil and 1,000,000-cir.-mil solder bonds were also shown. It had a great many interesting photographs showing the application of these bonds in the New York Central work. The representatives present were Messrs. H. L. Shippy, A. M. Whaley, of New York; G. R. Mitchell, James Henry, J. E. Nolan, M. G. Swartz, of Trenton; W. W. Affleck and J. W. Brooks, of Cleveland, and A. B. Conover, of Chicago.

The Heany Fire-Proof Wire Company, Chester, Pa., conducted a very effective experiment for the purpose of showing the heat resisting qualities of the Heany fire-proof wire. A coil wound with the wire was heated repeatedly to a sufficiently high temperature to ignite paper placed within the coil and this was done without any injury to the insulation of the wire. Mr. W. H. Easton, of New York, exhibited the wire. This wire is especially adapted for use in armatures and field coils and is manufactured in sizes from No. 3 to No. 00, the insulation being made to comply with the specifications for double cotton-covered wire.

The Crouse-Hinds Company, Syracuse, N. Y., was represented by A. F. Hind and Nathan Shute, of Syracuse; C. M. Crawford, of Cincinnati, and F. F. Skeel, of Chicago. They exhibited arc headlights, Syracuse incandescent headlights, "Harpoon" guy anchors and Condulets. The headlights were very interestingly displayed and one of a new design measuring 7 in. in depth over all, weighing but 17 lb. and designed so that it would not project beyond the bumper of the car, attracted considerable attention. On the private car "Martha" of the Indiana Traction Company, which was on exhibition near the entrance to the grounds, was one made all of solid brass. The specimens of conduit wiring in which Condulets of various styles were employed in place of the usual outlet boxes were very interesting. By the use of these devices outlets from conduit wiring were easily made without destroying the rigidity of the conduit.

The American Instrument Company, Philadelphia, Pa., exhibited a complete line of switchboard and portable instruments,

the merits of which were explained by Messrs. J. G. Biddle, T. G. Seixas and A. B. Weeks. The voltmeters and ammeters were shown assembled, and also the unassembled parts of these instruments were displayed. An interesting feature of these instruments is the construction of their pivots and bearings. The large copper terminal permits the smallest amount of shunt metal and the shunts are constructed of metal having no thermal e.m.f. with copper. All the shunts are interchangeable and operate with a 50-millivolt drop across the terminals. The instruments are standardized electrically as well as mechanically.

The Dayton Manufacturing Company, Dayton, O., was represented by Nelson Emmons, Jr., assistant general manager; Peter Leidenger and George W. Frost. They showed some interesting fittings for the interior of electric cars and a complete display of arc and incandescent headlights.

The Chicago Pneumatic Tool Company, Chicago, Ill., was well represented by its president, Mr. J. W. Duntley; vice-president, W. I. Duntley, manager of railroad department; C. E. Walker, T. Aldcorn, Eastern sales agent; C. B. Coates, electrical engineer, and Edward Aplin, salesman. They exhibited a complete line of pneumatic and electric tools, including several types of drills and grinders. These tools are built especially for railroad use and to operate on a 500-volt circuit without the use of any external resistance. The drills are built in sizes from ⅞ of an inch to 2 in. Their efficiency is shown by the fact that a drill weighing 35 lb. was designed to drill a ⅞-in. hole through the web of an ordinary rail in less than two minutes. An emery wheel which weighed but 28 lb. was driven by one of the portable grinders at a speed of 2,500 r.p.m.

The Automatic Electric Company, Chicago, Ill., had its exhibit in charge of Roy Owens, superintendent of the switchboard department of the Citizens' Telephone Company, Columbus, Ohio. The exhibit consisted of an automatic telephone exchange and the installation was so made that the operation of the selector switches could be seen. Several telephones were connected in the booth so that all details of the communication between them could be studied.

The W. N. Matthews & Bro., St. Louis, Mo., exhibited in a very effective manner their Kearney cable clamp and Stombaugh guy anchors. Poles were erected in the booth and guyed to the Stombaugh anchors. These poles carried cross arms on which were strung cables in such a manner that two right angle turns were made in the direction of the lines. The Kearney cable clamps were used in making these turns, thereby showing the advantage of their use. The display also included "Holdfast" lamp guards, the Leina jack box and plug and O. K. sleet cutters. Those in attendance were Claude L. Matthews, James R. Kearney and R. W. Harms, of W. N. Matthews & Bro., and D. L. Monjo, of the Wesco Supply Company.

The Lagonda Manufacturing Company, Springfield, Ohio, made an attractive show of its Weinland boiler tube cleaners, showing both the turbine and belt-driven types. It also showed its automatic stop and non-return crown valves, tube cutters and new damper regulator. The cleaners were mounted on a frame and kept in operation by a small motor. Twenty-four different types of cleaner heads were exhibtied on this frame. Those in charge of the exhibit were W. F. Weinland, M. M. Sellers and F. S. Davidson.

The Peerless Rubber Manufacturing Company, New York, was represented by G. S. Taylor and C. S. Prosser. The exhibit consisted of samples of the company's rubber products, including its famous Rainbow packing, air brake, steam and pneumatic hose, valve packing, gaskets and step treads. It distributed a handsome souvenir in the form of a pocketbook.

The F. Bissell Company, Toledo, Ohio, was represented by F. M. Bissell. As usual he succeeded in making additions to his already large list of friends and left a pleasing impression of his switchboards and general electrical supplies.

The Novelty Incandescent Lamp Company, Emporium, Pa., exhibited most attractively its incandescent lamps. Considerable attention was attracted by its opal lamps which are specially adapted for use in electric cars. It also showed in conjunction with the lamp exhibits its Black Hawk dry battery. Mr. R. K. Mickey, president of the company, was in charge of the booth, assisted by A. J. Jackson, of Albin & Jackson, Western agents of the company.

The Harrison Safety Boiler Works, Philadelphia, Pa., were represented by I. E. Harris, of Philadelphia, who explained the advantages of a 250-hp Cochrane feed-water heater and steam separator. The steam separator was sectionalized so that the interior construction, including the position of the baffle, could be readily studied.

The Buckeye Electric Company, Cleveland, Ohio, was represented by Messrs. Bliss & Evans. The lobby of the Chittenden Hotel was very brilliantly illuminated by Buckeye tantalum and Buckeye lamps and this attracted considerable attention and was most favorably commented upon. The company makes a special type of Buckeye lamps for street railway service.

The J. O. Devine Company, Buffalo, N. Y., was represented by Mr. E. C. Benedict, who explained the merits of the Passburg vacuum drying and impregnating apparatus, which this company makes, and which is largely used by manufacturers and repairers of coils, etc.

The Locke Insulator Manufacturing Company, Victor, N. Y., was well represented by its manager, Mr. J. S. Lapp. He had in the booth of the Electric Service Supplies Company samples of Victor high-tension insulators of various sizes and types.

The Yale & Towne Manufacturing Company showed two new motor-driven hoists, the motor being designed for street car circuits where the voltage fluctuation is great. One of the hoists had a controller giving two speeds for raising and lowering. These cranes were portable, being shifted either by hand or motor drive. The company is just installing a 2-ton ash and coal conveyor with 800 ft. travel, both motor-driven and motor-operated, for the Nashville Railway & Light Company. Several hand-power cranes were shown, including a 20-ton triplex block for power houses and shops. It could be operated from one or both sides, the use of the chains giving double the raising or lowering speed that could be secured with one chain. C. W. Beaver and H. E. Deckerman were in charge.

Dossert & Co., of Chicago, showed the Dossert solderless connection for cables, motor leads and other heavy feed wires. The railing around the booth was put up with these joints. E. A. Dossert and H. B. Logan explained the advantages of the joint.

The Standard Paint Company, of New York, showed samples of its P. & B. clear baking varnish, a new line; also samples of ruberoid car roofing. H. P. Benedict, J. T. Thomas, F. P. Barker, J. H. Vail and H. H. Cowhurd were present.

The Standard Varnish Works, of New York, showed samples of its insulation for coils, featuring the solid compound being used in connection with the Passburg impregnating process, which is growing largely in favor. F. A. Elinquist, John Dolf and L. Robinson were in charge.

The Buckeye Engine Company's stand was constantly a center of attraction, especially for the ladies, because of the distribution of roses and carnations and souvenir buckeyes. The company displayed a large number of photographs of large installations in this district, and especial attention was called to the new Buckeye gas engine which the company is preparing to push as soon as a tremendous flood of orders for standard steam engines has been relieved somewhat. V. T. Price, of Cincinnati; G. A. Pope, of Cleveland, and J. F. Castle were the hosts.

The W. R. Garton Company, of Chicago, which has the Central West agency for a large number of manufactured articles, had an extensive exhibition, and a number of the manufacturers had special exhibits with those of their agent. The Lima Porcelain Insulator Company, of Lima, N. Y., showed a line of high and low-tension insulators, making a feature of insulators designed for 180,000 volts for a Western transmission company. The Lord Electric Company, of Boston, showed a line of Thomas bonds and Shaw lightning arresters. The American Electric Company, of Chicago, showed its railway dispatching car and line telephones, a new line recently taken up by the Garton Company. The telephones are designed for either central energy or local magneto operation. On the car telephone the cord was attached to the telephone with a reel and plug, the plug being attached to jack boxes on poles. E. W. Bliss & Co., of New York, had samples of gears, pinions and gear cases, the latter having wood sides and steel rims. The Lord Electric Company

had present Edwin H. Hamlin and George B. Crane. The American Electric Telephone Company was represented by H. Henderson and the E. W. Bliss Company by B. W. Stone. The Garton company's force included W. R. Garton, C. E. Ewing, L. E. Bearbaum and H. M. Kennedy.

Albert & J. M. Anderson Manufacturing Company, of Boston, featured a new high-tension oil switch operating device. It was designed to be thrown by an automatic overload relay or by a trip on the switchboard. The throwing of the switch on the board energizes a magnet in the base of the switch mechanism and throws up a plunger into a dash-pot, which gives a cushion effect to the opening of the oil switch. Several other varieties of switches were shown. J. M. Anderson, Ernest Woltmann and N. W. Hincher were present.

The G. W. Lord Company, of Philadelphia, which for the past forty-five years has supplied practical and satisfactory boiler compounds and chemicals, was represented by Col. Nat P. Lane, Capt. J. E. Dougherty, V. L. Lawrence and Edward McCarthy.

The H. W. Johns-Manville Company, of New York, had an extensive exhibit in Building No. 4. Among the items which attracted particular attention were applications of "Transite" asbestos insulating and fire-proof lumber in the form of doors for high-tension transformer and switch rooms, and a line of "Noark" enclosed fuses, blocks, contacts and fittings for voltages from 110 to 10,000. The representatives in attendance were J. W. Perry, manager electrical department, New York; H. M. Voorhis, Philadelphia; J. W. Hardy, Milwaukee; F. E. Johnson, St. Louis; H. M. Frantz, Chicago; R. R. Braggins, Cleveland; R. W. Harnes, New York; C. B. Reed, Pittsburg; Harry Gillett, Cleveland, and R. B. Montgomery, Pittsburg.

G. M. Gest, engineer and contractor, was represented by W. T. Jackson, commercial engineer.

The General Electric Company, among its exhibits, showed a portable air compressor outfit. It consists of a portable truck with 4-ft. by 5-ft. platform, a compressor, governor and gauge being mounted on top of the platform while the tanks are located beneath. Much interest was shown in the tube of the mercury arc rectifiers. A complete exhibit was made of the General Electric single-phase railway system, an adaptation of the Sprague-General Electric multiple-unit control system to single-phase work. The equipment shown is one of a number being manufactured fnr the Central Illinois Construction Company. An interesting feature of the exhibit was an air compressor from which various parts have been so cut out as to permit examination of all the details of construction of both the electrical and mechanical mechanism. For the first time at any convention there is exhibited in the General Electric Company's space a commutating pole motor for railway use. This motor is known as the GE-100 and has a normal rating of 100 hp. In selecting line material for exhibiting at Columbus, the General Electric Company brought only some of its latest devices, particular attention being paid to the subject of catenary construction. A few other general railway supplies, including a sample board of rail bonds, arc also shown. A large automatic circuit-breaker shown consists of a motor-operated circuit-breaker in combination with a main switch, also motor-operated. It has a capacity of 12,000 amp. at 650 volts. The circuit-breaker and switch may be controlled from a distance, being necessary to run only one wire from the switchboard to the point of control. The exhibit space was lighted by 250-watt Gem lamps with Holophane reflectors. Besides these, the new tantalum lamp was also used in the most effective manner. The General Electric Company's arrangements at the convention were complete. Among those representing the company were the following: J. R. Lovejoy, Schenectady; C. C. Peirce, Boston; G. D. Rosenthal, St. Louis; H. L. Monroe, Chicago; R. F. Moore, Philadelphia; E. H. Ginn, Atlanta; J. J. Mahoney, New York; H. H. Crowell, Buffalo; E. H. Anderson, C. E. Barry, H. N. Ransom, E. D. Priest, W. G. Carey, F. E. Case, Schenectady; W. J. Hanley, Columbus; M. M. Corbin, Cincinnati; H. H. Corson, Memphis; Frank H. Gale, manager of publicity.

The National Brake & Electric Company, of Milwaukee, supplied a handsome setting for its extensive exhibit in Building 3, an effective color scheme of decoration having been worked out. The new National air compressor attracted much attention, its merits being well brought out by sectional views of details, and the same remark applies to the company's new oil pneumatic governor, engineer's valve and emergency valve. A new type of electric motor from 3 to 40 hp for machinery drive was shown. The National Company was represented by S. I. Wailes, sales manager; R. P. Tell, general manager; W. L. Waters, chief engineer; Griffith Johnson, general superintendent; J. T. Cunningham, New York representative; C. N. Leet, Bert Aikman, W. M. Bisel and W. H. Beattys, Jr., of the Chicago office; Geo. S. Hastings, Cleveland representative; J. T. Perry, of the San Francisco office; W. H. Goble, of the Philadelphia office; Arthur Jones, of the Arthur Jones Company, Illinois representatives; R. W. Woodward, of the Milwaukee office, and R. W. Hutchinson, Jr., manager of the publicity department.

Westinghouse Exhibits.—The Westinghouse exhibits occupied one whole side of the Agricultural Building, in the Fair Grounds, Section C, 4 to 19. The exhibit was lighted entirely by Nernst lamps and Cooper Hewitt mercury vapor lamps. In a tent immediately behind the reception room the companies had arranged a photographic studio, in which their photographer took group views of members of the Street Railway Association and their friends. These pictures will afterwards form a part of an album which the companies have had prepared as souvenirs for the occasion. This album will be mailed from the head offices at Pittsburg, the week following the convention. A souvenir was distributed in the form of an illustrated postal card exemplifying a "Transfer." Instead of punching out the dates and transfer points, the employes of the company at the exhibit punched out the date of the arrival of the delegate, the date on which he expected to return, as well as the hotel at which he was stopping. These were addressed at the exhibit and mailed to such friends as the delegates wished to remember in this way. The exhibit of the Westinghouse Electric & Manufacturing Company was made up of a most comprehensive line of car motors and of apparatus suited for electric railways, an operating exhibit of the Westinghouse unit group system of multiple control, a line of arc lamps, circuit-breakers, lightning arresters, fuses, fuse blocks, ceiling, desk and wall electrical fans, and artistically arranged on boards was the overhead line material manufactured by the company. The Westinghouse Traction Brake Company had working racks of air brake equipments and a number of cars on exhibit in other sections were fully equipped with Westinghouse air brake apparatus of the improved type. The Westinghouse Companies were represented at the convention by the following men, including some of their high officials: Westinghouse Electric & Manufacturing Company—Mr. W. M. McFarland, acting vice-president; Mr. C. S. Cook, manager railway and lighting sales; Mr. C. B. Humphrey, manager detail and supply sales; Mr. R. W. Beebe, Cleveland; Mr. J. A. Brett, Cincinnati; Mr. R. S. Brown, Boston; Mr. L. M. Cargo, Denver and Salt Lake City; Mr. W. L. Conwell, New York; Mr. Thomas Cooper, Philadelphia; Mr. H. P. Davis, Pittsburg; Mr. J. L. Davis, Pittsburg; Mr. W. F. Fowler, Pittsburg; Mr. G. H. Gibbs, Cincinnati; Mr. J. J. Gibson, Philadelphia; Mr. G. B. Griffin, Pittsburg; Mr. J. R. Gordon, Atlanta; Mr. S. J. Keese, Los Angeles; Mr. S. J. Kintner; Mr. C. W. Regester, Chicago; Mr. F. F. Rohrer, Pittsburg; Mr. F. H. Shepard, Pittsburg and New York; Mr. O. T. Smith, New York; Mr. H. C. Stier, Pittsburg; Mr. C. F. Scott, Pittsburg; Mr. N. W. Storer, Pittsburg; Mr. J. E. Webster, Pittsburg; Mr. G. C. Ewing, Boston; Mr. J. T. Queeny, Boston; Mr. J. G. Swain, Pittsburg; Mr. N. S. Braden. Westinghouse Machine Company—Mr. J. B. Allen, Mr. C. C. Chappelle, Mr. H. D. Watson, New York; Mr. Ed. Yawger, Mr. H. H. Kerr, Chicago; Mr. W. G. Wagenhurst. Nernst Lamp Company—James L. Anderson. Westinghouse Air Brake Company—Mr. G. W. Baker, Mr. W. S. Bartholomew, Mr. Robert Burgess, Mr. E. A. Craig, Mr. E. H. Desson, Mr. C. R. Ellicott, Mr. J. R. Ellicott, Mr. A. L. Humphrey, Mr. S. D. Hutchins, Mr. A. Johnson, Mr. J. F. Miller, Mr. F. M. Nellis, Mr. J. C. Olmsted, Mr. C. W. Townsend, Mr. W. V. Turner, Mr. F. A. Estep, president and treasurer R. D. Nuttall Co.; Mr. G. V. Williams, Sawyer-Man Co., New York; Mr. J. C. McQuiston, publishing department, in charge of the exhibit; Mr. L. A. Shepard, secretary Atha Steel Casting Company.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—A large volume of trade was reported and active retail demand induced a heavy volume of re-order business from jobbers. Retail trade in staple lines is broadening with the advancing season, and wholesale and jobbing departments make satisfactory returns. There was a definite improvement in the promptness with which mercantile collections are made. In general distributive lines uniformly favorable reports were received. There is great activity in the industries; the iron and steel, metal working, coke, cotton and other textiles, furniture, carpet and practically all lines are pushed. New building permits have decreased somewhat, which is only seasonable, and conservative authorities welcome the lessened speculative activity in real estate. Building permits in San Francisco to the value of $18,000,000 have been issued, and 35,000 men connected with building trades are steadily employed, while 10,000 laborers are working at street railway construction and débris clearing. Many voluntary advances in wages are noted. Railway blocks still delay shipments, yet the earnings for October thus far surpass last year's by 7.5 per cent. The feature of the iron and steel trades is the pressure to produce sufficient quantities to meet requirements. High prices and premiums for prompt deliveries seem to be the rule. The demand for structural material and plates continues good, with car builders figuring largely in the tonnage ordered. New orders for steel rails are only moderate. Copper is firm though buying is limited. The recent advances at home and abroad in new and old copper stimulated the international markets throughout the week. For large tonnage electrolytic and Lake bring 22½ to 25⅝c. net, New York, for January and February. For small tonnages 23 to 24c. was the range of prices. Casting copper, 30 days, was strong at 22½ to 22⅝c. in large tonnages, prime brands. The business failures during the week ending October 18, according to *Bradstreet's*, numbered 170 against 192 the week previous, and 178 in the corresponding week of last year.

SEPTEMBER FOREIGN TRADE.—The chief of the U. S. Bureau of Statistics, Department of Commerce and Labor, reports the foreign commerce of the United States for September and nine months ending September as follows:

September:

	MERCHANDISE.		
	1906.	1905.	1904.
Imports	$102,286,393	$102,138,031	$84,124,975
Exports	138,950,930	136,005,822	134,265,424
Excess exports	$36,664,537	$33,867,791	$50,140,449

Nine months ending September:

Imports	$947,935,187	$872,548,988	$751,394,339
Exports	1,238,277,400	1,102,575,831	985,468,881
Excess exports	$290,342,213	$230,026,843	$234,074,542

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph instrument statements for the month of September and nine months compare as follows:

September:

	1906.	1905.	1904.	1903.
Gross output	131,926	160,613	106,305	79,406
Returned	69,660	51,494	38,353	33,438
Net output	62,266	109,119	67,952	45,968

Nine months ending September 30:

Gross output	1,680,296	1,301,058	876,609	812,229
Returned	555,717	457,405	374,925	358,831
Net output	1,124,579	843,653	501,684	453,398
Total outstanding	6,822,837	5,324,217	4,281,201	3,608,718

It will be noted that the total outstanding has nearly doubled since 1903, and it must now represent nearly, if not quite, 3,250,000 subscribers.

CROCKER-WHEELER ORDERS.—The following list of recent sales made by the Crocker-Wheeler Company, of Ampere, N. J., shows that the company's customers are not confined to any one industrial line. These sales are as follows: Marine Engine & Machine Company, Harrison, N. J., four 25-hp, 230-volt, direct-current motors. American Car & Foundry Company, Berwick, Pa., one 500-kw, 250 volts, 100 r.p.m. direct-current generators. Van Wagoner Construction Company, New York, two 100-kw, 250 volts, 250 r.p.m. and one 50-kw, 250 volts, 275 r.p.m. direct-current generators. Lawrence Duck Company, Lawrence, Mass., one 170-hp, 230 volts, shunt-wound motor. Brown-Lip Gear Company, Syracuse, N. Y., one 160-kw, 257 r.p.m., 240 volts, engine-type generator. Baldwin Locomotive Works, Philadelphia, Pa., four 175-kw, 250 volts, 160 r.p.m. direct-current generator, driven by Diesel engine. Standard Oil Company, N. Y., one 100-kw, 125-volt, direct-current generator, driven by Ames engine. Sandusky Portland Cement Company, Sandusky, O., two 400-kw, 440-volts, alternating-current generator, and one 100-kw, 125 volts, 250 r.p.m. direct-current generator. W. & J. Knox Net & Twine Company, Baltimore, Md., one 750-kw, 250 volts, 100 r.p.m. direct-current generator.

THE HOOVEN, OWENS, RENTSCHLER CO., of Hamilton, Ohio, has licensed the Felten-Guilleaume, Lahmeyer Werke, Frankfort-on-Main, Germany, to build the "Hamilton-Holzwarth" turbine throughout Germany. The Felten-Guilleaume, Lahmeyer Werke Co. is one of the largest electrical concerns of Germany, with a capital of $20,000,000. It manufactures both water and steam turbines, wire cables, generators, motors and all classes of electrical machinery, having recently bought the control of Escher, Wyss Co., Zurich, Switzerland, thus controlling the Zoelly Steam Turbine Syndicate, of Germany. The Felten-Guilleaume, Lahmeyer Werke Co. has taken up the manufacture of the "Hamilton-Holzwarth" turbine after a very careful investigation and a series of most careful tests on this particular type of machine at the University of Darmstadt. The acceptance of the turbine was made on a basis (of the "Hamilton-Holzwarth" turbine, after a series of tests) being equal to or better than any turbine of the same size and speed in operation in Europe. The tests referred to above will be ready for publication in a few weeks. The Hooven, Owens, Rentschler Co., of Hamilton, Ohio, has a duplicate of this machine at its works, which has also been tested out. This turbine is of the 500-kw size, three-phase, 60-cycle, 2,300-volt, adapted for 1,800 r.p.m.

THE BETHLEHEM STEEL CO., of South Bethlehem, Pa., has placed an order with the Crocker-Wheeler Company, of Ampere, N. J., for the complete electrical equipment in its new rolling mill, amounting to about 6,000 hp in motors. The mill includes rail making machinery, cooling beds, equipped for pull-on and rake-off attachments, the necessary machine tools, etc. The greater part of the motor equipment will consist of Crocker-Wheeler Form W rolling mill motors, the first and only line of motors ever built specifically for excessively heavy rolling mill service. All sizes of this machine will be represented, 25 hp., 50 hp., 75 hp and 100 hp. There will also be a number of the special open three-bearing generator type of Crocker-Wheeler motor, giving outputs of 115 hp and 225 hp. The celebrated Form I machine tool motor in various sizes, as well as several of the Crocker-Wheeler crane motors, are included. The placing of this order is a further recognition of the Crocker-Wheeler rolling mill motor and of the ability of the company to handle complete rolling mill equipments.

A NEWARK LEATHER PLANT.—M. Straus & Sons, of Newark, N. J., have recently let the contracts for engine, generator, exciter, induction motors and switchboard for their newly built leather establishment at Newark, to the Allis-Chalmers Company, of Milwaukee. The new equipment will consist of a 16-in. by 36-in. Reliance single engine, direct-connected to a 150-kw A1 Generator, 60 cycles, three-phase, 240 volts. The exciter is a 13-kw type H machine operating at a speed of 550 r.p.m., 120 volts. The induction motor equipment will include twenty motors 220-volt, three-phase, aggregating 138 hp. They will range from two to fifteen horse-power capacity and operate at speeds from 900 to 1,800 r.p.m. The switchboard consists of generator and feeder panels of polished black enameled slate. The engine will operate at a speed of 120 r.p.m., non-condensing, under pressure of from 90 to 100 lb.

ALLIS-CHALMERS PLANT FOR KENOSHA, WIS.—The Chicago Brass Company, whose works are situated at Kenosha, Wis., has recently concluded the purchase of an Allis-Chalmers engine and generator outfit for addition to its present equipment. The new units are comprised in a 20 and 42 by 42-in. Reynolds Corliss cross-compound engine of the heavy-duty type, direct-connected to an Allis-Chalmers 550-kw engine type generator, 240 volts, which will operate at a speed of 100 r.p.m. The receiver for the engine is provided with a connection from which steam

may be taken for heating purposes. The engine will have long range gear and double eccentrics on both sides. A belt rider safety stop will be provided for the governor.

SALES OF APPARATUS.—Mr. George Bender, 137 Centre Street, New York City, reports a brisk demand for second-hand electrical machinery. Among recent sales are a 100-kw dynamo to J. B. Lyon & Co., Albany, N. Y.; a 40-hp motor to S. B. Clark, New York; two 30-hp motors to the Attleboro Steam & Electric Company, Attleboro, Mass.; a 20-hp to Brass Specialties Company, New York; a 20-hp to American Agricultural Chemical Company, Preston Branch; a 15-hp to National Seed Company, Bradley Branch; a 20-hp to Hartford Machine Screw Company, Hartford, Conn.; a 10-hp to J. B. & J. M. Cornell, Cold Spring, N. Y.; a 10-hp to Yale & Towne, Stamford, Conn.; also several small motors around New York City.

ALLIS-CHALMERS UNITS FOR OXNARD, CAL.—The Ventura County Power Company, of Ventura, Cal., will install a new power station at Oxnard, the equipment for which has recently been contracted for with the Allis-Chalmers Company of Milwaukee. The outfit will comprise a standard 300-k.w. Allis-Chalmers engine type generator, designed to operate at 125 r.p.m., 50 cycles, 3 phase and 2,300 volts. The generator will be separately excited and will be driven by a Reynolds Corliss tandem compound condensing engine of the heavy duty type, operating at a speed of 125 r.p.m. The engine is to be fitted with a complete electric synchronizing device and will have valves in the heads of both cylinders.

DUTY ON INSULATING PITCH.—In a decision by Eugene G. Hay, the Board of United States General Appraisers overruled last week a protest filed by the Safety Insulated Wire & Cable Company of this city, it being held that cotton-seed pitch used in connection with insulating cables for electrical purposes must pay duty at the rate of 20 per cent. The importing firm made several claims for exemption from duty and two claims for assessment at the rate of 10 per cent. The board holds that Collector Stranahan's assessment under the provision in the tariff for non-enumerated manufactured articles will stand.

STURTEVANT ENGINES.—That the new design of vertical enclosed engine with forced lubrication and watershed partition manufactured by the B. F. Sturtevant Co., of Boston, Mass., is rapidly increasing in favor is evidenced by such recent sales as the following: Freidberger-Aaron Manufacturing Company, Germantown, Philadelphia, Pa.; Norfolk & Washington Steamboat Company, Washington, D. C.; Thomas & Smith, Chicago, Ill.; Department of Docks and Ferries, New York City; Cumberland Valley Railroad Company, Chambersburg, Pa., and Henry R. Worthington, Harrison, N. J.

THE GENERAL STORAGE BATTERY COMPANY with offices at 42 Broadway, New York City, N. Y., has increased its business to such an extent that it has been obliged to enlarge its present works at Boonton, N. J. Additional generating units are being installed, and the additional switchboard equipment consists of twenty-one generator and feeder panels. The new building which is being added will be a structure of five stories and basement, for which a separate power station will be erected.

WESTERN ELECTRIC ACTIVITY.—The Western Electric Company reports a record volume of business. In the first six months of the current year its gross earnings increased 40 per cent. over the corresponding period of last year; gross from January 1 to June 30 last year increased in turn over the preceding year approximately 30 per cent. The company now has in its employ about 25,000 men, approximately 10,000 of whom are in New York city, and some few thousand abroad.

TROLLEY WORK OFFERING.—The U. S. Bureau of Manufactures notes the following foreign opportunities: (1) Consul-General George Horton, of Athens, writes that the trolley cars are about to be purchased for the new electric car line in the Greek capital. (2) The Societa Veneta di Costruzioni, Padua, Italy, wishes to purchase electric car line equipment. (3) Municipality of Cologne, Germany, will spend $125,000 for 46 motor trolley cars and 40 trailers.

FOR SUGAR PLANTATION.—The export department of the Westinghouse Electric & Manufacturing Co., has received an order for the electrical equipment of one of the largest sugar plantations in the island of Cuba. This is the Nipe Bay Sugar Manufacturing Co., of Nipe Bay, located on the northern coast of Cuba.

GEO. E. LUM MACHINE & SUPPLY COMPANY, of 1918 Morris Avenue, Birmingham, Ala., is establishing an electrical department to handle electrical generating, power and mining machinery, in connection with its existing business, and it invites correspondence in this connection.

TELEPHONY IN DENVER.—The Automatic Telephone Company is seeking a franchise in Denver. The matter will be voted on November 6. The Colorado Telephone Company, Bell system, is opposing the new concern. There is no telephone competition at present.

PLANT FOR PHILIPPINES.—The B. F. Sturtevant Co., of Boston, Mass., has recently sold for export to the Philippine Islands one of its new design generating sets consisting of enclosed forced lubrication engine and generator of its own make.

ALLIS-CHALMERS.—The plants of the Allis-Chalmers Company, when completed, will have in the neighborhood of 15,000 men on the pay roll. The orders on the books represent approximately $12,000,000.

CURTIS STEAM TURBINE ORDER.—The General Electric Co. has, within the past few days, received an order from the New York Edison Co. for four steam turbines of 8,000 kw. capacity each.

Financial Intelligence.

THE WEEK IN WALL STREET.—Speculation on the New York Stock Exchange early in the week was restricted. The uncertainty in the New York State election was a discouraging element in the market, which produced hardening tendencies in money, and on Friday there was a break in prices from which a moderate recovery ensued. This break was due to the unexpected announcement that the Bank of England rate had been advanced to 6 per cent. The entire list suffered in varying proportions and the partial recovery was somewhat irregular. Amalgamated Copper took the lead in active interest, the trading in that stock turning on the question of the dividend rate. The likelihood of a 1 per cent quarterly dividend on United States Steel common was discussed, and the steel issues at first showed a fair degree of strength. On Saturday prices broke violently; first, because of the rapid decline in American shares at London; then because of an extremely weak bank return. The $6,823,000 shrinkage in surplus bank reserves was, it is stated, the consequence of the Bank of England's operations against our foreign borrowings. Electric stocks declined in keeping with the general market. Allis-Chalmers common lost 5/8 points and preferred 2 points, net, the closing quotations being 16 5/8 and 43, respectively. American Locomotive common dropped 4 1/2 points and preferred 1/2. General Electric closed at 175, which is a net loss of 4 1/2 points, and Westinghouse was steady throughout the week at 154, this being a net decline of 2 points. There was a limited business in Brooklyn Rapid Transit, the closing quotation being 76 7/8, which is a decline of 1 1/4 points. Metropolitan Street Railway was an exception and made a net gain of 1 point, closing at 107; while Interborough-Metropolitan, both common and preferred, declined 1 3/8 points each, the closing prices being 36 1/8 and 75 5/8, respectively. Western Union closed at 86, which is a fraction lower than the last previous quotation. On the curb market there was a good deal of activity in copper and other mining stocks. On Friday the sudden break of the general market was reflected on the curb, and at the close of the week outside securities were very heavy. Following are the closing quotations of October 23:

NEW YORK

	Oct. 16	Oct. 23		Oct 16	Oct 23
Allis-Chalmers Co.	17	17¼	General Electric	178¾	175¼
Allis-Chalmers Co. pfd.	44	43½	Hudson River Tel	...	...
American Dist. Tel	25	25	Interborough Rap. Tran.	...	...
American Locomotive	76⅛	74⅜	Mackay Cos.	70¼	71
American Locomotive pfd.	112	110	Mackay Cos pfd.	70¾	69¾
American Tel. & Cable	87	87	Marconi Tel	...	...
American Tel & Tel.	...	...	Metropolitan St. Ry.	...	...
Brooklyn Rapid Transit	78⅛	78¼	N. Y. & N. J. Tel.	...	...
Electric Boat	15	15	Western Union Tel.	86¾	86⅜
Electric Boat pfd.	60	50	Westinghouse com.	154	150
Electric Vehicle	11	11	Westinghouse pfd.	...	...
Electric Vehicle pfd	18	18			

BOSTON

	Oct 16	Oct. 23		Oct. 16	Oct. 23
American Tel & Tel.	136⅜	136	Mass. Elec. Ry pfd	70	...
Cumberland Telephone	...	...	Mexican Telephone	...	3¾
Edison Elec. Illum	235	235	New England Telephone	130	130
General Electric	178¼	175½	Western Tel & Tel.	...	...
Mass. Elec. Ry	18¼	9	Western Tel. & Tel. pfd.	85	85

PHILADELPHIA

	Oct. 16	Oct. 23		Oct. 16	Oct. 23
American Railways	51⅛	51⅛	Phila. Electric	8⅞	8⅛
Elec. Co. of America	12¾	11¾	Phila. Rapid Trans.	28⅜	28⅛
Elec Storage Battery	71⅛	70	Phila. Traction	...	97¾
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Oct. 16	Oct. 23		Oct. 16	Oct. 23
Chicago City Ry.	140	140	National Carbon	...	85
Chicago Edison	145	...	National Carbon pfd.	...	116
Chicago Subway	...	...	Union Traction	...	...
Chicago Tel. Co.	...	...	Union Traction pfd.	...	...
Metropolitan Elev com.	...	25			

DIVIDENDS.—The directors of the Helena (Mont.) Light & Railway Company have declared a quarterly dividend of 1¼ per cent on the preferred stock and 1 per cent on the common, payable October 31. The directors of the Twin City Rapid Transit Company have declared a quarterly dividend of 1¼ per cent on the common stock, payable November 15. The directors of the Chicago Edison Company have declared the regular quarterly dividend of 2 per cent, payable November 1. The Edison Electric Illuminating Company, of Brockton, semi-annual dividend of $2.50 per share, has been declared payable November 1 to stockholders of record October 18. Transfer books close on October 17 and will reopen on November 2. The Lowell Electric Light Corporation has declared the semi-annual of $4 per share, payable November 1. The American Light & Traction Company has declared the regular quarterly dividend of 1½ per cent on the preferred and 1¼ on the common, payable November 1. The directors of the Wire & Telephone Company of America have declared a dividend at the rate of 6 per cent per annum on the preferred stock of the company to July 1, 1906, payable November 15. The directors of the Electric Securities Corporation have declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable November 1. A semi-annual dividend of $5 per share has been declared on the stock of Tampa Electric Company, payable November 15, to stock of record, November 1. The directors of the Montreal Light, Heat & Power Company have declared the regular quarterly dividend of 1¼ per cent, payable Nov. 15. The Central District & Printing Telegraph Company, of Pittsburg, has declared the quarterly dividend of 2 per cent, payable Oct. 31. Directors of the Electric Bond & Share Company have declared the regular quarterly dividend of 1¼ per cent. on the preferred stock, payable November 1. United Electric Securities Company has made its regular semi-annual of $3.50 per share on preferred, payable November 1. The Detroit United Railways has declared the regular quarterly dividend of 1¼ per cent. on the capital stock, payable November 1. The Toledo Railway & Light Company has declared a dividend of 1 per cent, payable November 1.

LIGHT INTERESTS MERGED.—Plans have been completed for the marger of about 30 electric lighting companies in Westmoreland, Allegheny, Fayette and Washington counties, Pa., October 24, under the name of the West Penn Electric Company, a company affiliated with the West Penn Railways Company. The parent company is controlled by Pittsburgh capital. The officers of the company are: President, William S. Kuhn; vice-president, James S. Kuhn; secretary, R. P. Watt; treasurer, J. von Wagoner; purchasing agent, H. F. Barnard; superintendent, W. E. Moore. The operating office is at Connellsville. The small concerns, the control of which has been secured, and which will be voted into the present company at meetings to be held before the end of the month, are at the following points: Charleroi, Brownsville, Monongahela City, Smithfield, New Haven, Greensburg, Vanderbilt, Emerson, Youngwood, Youngstown, Bellevarnon, Carroll. Fallowfield, Fayette City, California, Coal Center, Stockdale, Rostraver, Speers, West Pike Run, Twilight, Monessen, North Charleroi, Allen and Elco.

INTERSTATE TELEPHONE CO.—At a meeting held in Allentown, Pa., last week the Reorganization Committee of the Interstate Telephone Co. of New Jersey reported having purchased at foreclosure sale the property of the company and turned it over to the Reorganization Committee. A new company was then formed, under the name of the Interstate Telephone and Telegraph Company, of New Jersey, with these directors for the ensuing year: W. S. Hancock, Trenton; A. J. Bakewell, New York; John Markle, Jeddo; Robert E. Wright and Charles West, Allentown; George N. Reichard, Wilkes-Barre, and H. R. Swartz, Trenton. Mr. Swartz will be chosen president and general manager of the company. The Interstate is an independent company operating in New Jersey. It has about 8,000 subscribers, with exchanges in Trenton, Atlantic City, Elizabeth, Paterson, Passaic and twenty-five smaller towns. This company is separate from, but will work in harmony with the Consolidated Telephone Companies of Pennsylvania.

DYNELECTRON BUBBLE.—Last week, Vice-Chancellor Pitney, sitting in Newark, N. J., began the taking of testimony in the suit of Michael J. Tansey against the International Dynelectron Company of the District of Columbia. Mr. Tansey owns 3,000 shares of stock of the Dynelectron Company of Arizona and is suing to set aside an agreement by which the Arizona corporation transferred all its assets to the defendant corporation for $20,000,000 of stock of the $50,000,000 stock issued and $1,000,000 in cash. The court styled the concern a palpable fraud and said that he doubted whether the suitor had any standing in court, as he did not believe the stock was worth $50, which is necessary to maintain the suit in court. Ex-Judge Francis Child, representing Mr. Tansey, assured the court that it would be proved that his client's holdings represented sufficient value to make the issue cognizable. The hearing has been continued.

ELECTRICITY AT MANILA.—The earnings of the Manila Electric Railroad & Lighting Corporation, for September, are reported from Manila by J. G. White & Company, operating managers, as follows:

Railway Department—	
Gross earnings	$37,500
Net earnings	14,100
Lighting Department—	
Gross earnings	34,000
Net earnings	19,500
Total gross earnings	71,500
Total net earnings	33,600

The most notable feature of these figures is the improvement shown in the ratio of net to gross earnings of the lighting department. In six months there has been an increase from 51 per cent to 57 per cent, through improvement in administration and the elimination of the old plant of La Electricista, the former lighting company.

ELECTRIC RAILWAY FINANCING.—Stockholders of the Washington, Baltimore & Annapolis Electric Railway Company will meet in Annapolis November 2, to vote on increasing the capital stock from $4,000,000 to $5,250,000, the new capital to be used in connection with financing the Baltimore Terminal Company, which is to furnish an entrance into Baltimore for the Washington line. Arrangements were recently completed in Cleveland for underwriting $1,250,000 of the Baltimore Terminal Company's 5 per cent first mortgage bonds. The Washington Company is to purchase all the stock of the Terminal Company, and it is said the new capital is to be exchanged, share for share, for that of the Baltimore company. The stock of the Washington Company thus issued, it is reported, will go to the subscribers of the underwriting as a bonus with their bonds.

CONNECTICUT REPORTS.—The Consolidated Railway Company, the trolley line of the New York, New Haven & Hartford, has just submitted its report for the year ended June 30 to the railroad commissioners. The capital stock outstanding is $10,000,000; bonds outstanding, $82,229,400; cost of equipment and construction, $26,495,945.07; gross earnings, $3,788,376.74; operating expenses, $2,274,747.94; net earnings, $1,513,628.80. The report of the Connecticut Railway & Lighting Company, the rival trolley through Connecticut, shows that the company's net income for that year was $386,951.03. This, with the previous year's surplus, makes a surplus of $573,783.73. The assets were on June 30 $30,572,309.50 and the liabilities the same, including preferred stock, $5,609,000; common stock, $9,181,000, and funded debt, $12,776,192.88.

WESTERN UNION BONDS.—It appears that counsel for the Western Union Telegraph Company have advised that a second special meeting of the stockholders be called to vote again upon the $25,000,000 bond issue which was authorized at the special meeting of stockholders on October 10. The directors have decided to act upon this advice, and the meeting is scheduled for November 23. The necessity for another special meeting to re-enact the proceedings of the meeting of October 10 arises from a doubt as to the interpretation of the law requiring that such meetings be advertised once in each of the two weeks preceding the meeting. At the first meeting the bond issue was authorized by a vote of 30,000 shares more than the required two-thirds.

A. & W. ELECTRIC SIGN COMPANY.—The A. & W. Electric Sign Company, of Cleveland, O., has been incorporated under the laws of Ohio with a capital stock of $25,000. Some well-known men are connected with this and the officers are: President, and treasurer, Mr. H. J. Walzer; vice-president, Mr. E. J. Kulas; secretary, Mr. W. Knapp.

SALE OF BELOIT PROPERTIES.—Representatives of the Union Savings Bank & Trust Company and the Queen City Savings & Trust Company, of Cincinnati, O., have purchased the controlling interest in the Beloit (Wis.) Water, Gas & Electric Company for about $250,000 to protect the bond holders.

INTERNATIONAL BELL.—At a special meeting in New York the stockholders of the International Bell Telephone Company last week voted to reduce the company's capital from $50,000 to $10,000 by reducing the par value of the stock from $5 to $1 a share. The company, a foreign corporation, is in process of liquidation.

GENERAL NEWS.

Construction News.

CARBON HILL, ALA.—The municipal electric light and water plant has been completed and accepted by the town. The plant was built under the direction of Edgar B. Kay, professor of engineering at the University of Alabama, at a cost of about $30,000. The town board desires to make a contract with a competent electrician to operate the plant. Charles Roland is mayor.

MOBILE, ALA.—Bids for the construction of a municipal lighting plant for the city of Mobile were opened October 12. Only two bids were presented: McCleary Company, of Detroit, Mich., plant to be constructed at a cost of $123,000. Joseph McWilliams Company, of Louisville, Ky., plant to be constructed at a cost of $137,800. Joseph H. Lyons, representing E. G. Bruckman, of New York City, asked that a former bid filed by his firm be considered. This concern offered to furnish the city with lamps at a cost of $63.50, and in ten years turn the plant over to the city in the best of condition. Mr. Bruckman proposed further to install the plant under the same roof of the municipal water works, resulting in the saving of over $2,000 yearly in the city in salaries.

KINGMAN, ARIZ.—F. F. Monteverde and other directors of the Mt. Desert Power & Water Company have decided to erect their power plant at Kingman. It is the intention of the company to furnish water and electricity for lighting and power in the town of Kingman and electricity for lighting the mining camps.

POMONA, CAL.——The directors of the Home Telephone Company have decided to make improvements to the local system to cost several thousand dollars.

SAN FRANCISCO, CAL.—The General Electric Power Company has filed a certificate of bonded indebtedness with the county clerk certifying to the increase of its bonds to $9,000,000, an increase of $1,500,000.

LOS ANGELES, CAL.—It is asserted that within the next six months an air-line electric railway will extend from Pasadena to Long Beach. Manager Linnard, of the Hotel Maryland, in Pasadena, and the Bixby, at Long Beach, admits the truth of such a statement. It is thought the road will follow the new short line from Pasadena east to Lamanda Park Junction, then south by the shortest route to Long Beach, coincident with the much-talked-of Huntington Drive Boulevard between the two places.

SAN FRANCISCO, CAL.—The San Francisco Gas & Electric Company has issued notices to its consumers of a reduction of the rates for both gas and electricity, the schedule taking effect October 1. The company makes a reduction below the established municipal rate in both gas and electricity in certain quantities. On electricity for lighting the municipal fixed rate is 9 cents to 5.4 cents, according to consumption, per 16-cp lamp equivalent per month for installed load; then according to gross quantity used, as follows. Upon the monthly consumption of: For 375 to 649 kw-hours, 5¼ cents per kw-hour; from 650 to 924 kw-hours, 5 cents; from 925 to 1199, 4¾ cents; from 1200 to 1474, 4½ cents; from 1475 to 1749, 4¼ cents; from 750 or over, 4 cents. On electricity for power with the municipal rate of 9 cents to 5.4 cents according to consumption per 16-cp equivalent per month for installed load; then according to gross quantity used as follows: Upon a monthly consumption of: From 375 to 449 kw-hours, 5¼ cents per kw-hour; from 450 to 549 kw-hours, 5 cents; from 550 to 674, 4¾ cents; from 675 to 849, 4½ cents; from 850 to 1099, 4¼ cents; from 1100 or over 4 cents.

CANON CITY, COL.—The Colorado Light & Power Company has awarded the contract for enlarging its plant at this place and making other improvements. A new power house will be erected; the capacity of the engines and generators will be increased from 2,500 to 5,000 hp.

NEW LONDON, CONN.—To meet the increasing demands for electricity for power purposes the New London Gas & Electric Company has recently installed a new 1,000-kw turbo-generator set made by the General Electric Company. It is said that the company is contemplating installing another General Electric steam turbine of 1,500 kw capacity in the near future. Alexander J. Campbell is manager.

EAST HAMPTON, CONN.—The Rhode Island Contracting & Engineering Company has transferred to the Salmon River Power Company all its property rights in this section. The latter company is capitalized at $500,000 and is bonded for $375,000. In addition to furnishing the East Haddam Electric Light Company, which supplies the towns of Chatham and East Haddam with lamps, it is proposed to light the city of Middletown and furnish power from there and elsewhere. The power plant is to be located at Leesville, electricity being transmitted by large copper wires to cities. There will be a large dam above and reservoir in Marlborough. Arrangements have been made with the Middletown Electric Light Company to furnish the electricity, which, under the contract, must be ready by August 1, 1907.

WINDSOR LOCKS, CONN.—The Northern Connecticut Power Company, which has taken over the Windsor Electric Light Company of this place, the Enfield Electric Light & Power Company and the Enfield Gas Company has perfected arrangements to consolidate the business of the two electric companies. The contract has been let for a consolidated plant, which will be located near the present Windsor Locks plant, and which will furnish electricity for light and power for Windsor Locks, Thompsonville and Enfield. A contract has been placed with the Allis-Chalmers Company for a 325-hp Reliance Corliss horizontal engine. A new 12-panel switchboard has been ordered from the Westinghouse Electric & Manufacturing Company. The material for the transmission line between Enfield and Thompsonville has been ordered and the poles are being distributed. Parker H. Kemble is manager.

WILMINGTON, DEL.—The damming of the Delaware River at New Hope and utilizing the water power for commercial purposes is again being agitated by capitalists and business men of Bucks County, and a bill will probably be introduced at the next session of the Legislature permitting a dam at Wells Falls.

WILMINGTON, DEL.—John W. Endean, who has his headquarters in Smyrna, is endeavoring to organize a company to build an electric railway to extend from Wilmington to Lewes. Mr. Endean is arranging to incorporate a company to be known as the Diamond State Rapid Transit Company, and secure franchises in rural New Castle County to Delaware City and in the lower counties. It is to be incorporated with a capital stock of $1,250,000 and bonded for $2,500,000.

WASHINGTON, D. C.—Bids will be received until November 13 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the Navy Yard, Washington, D. C., one planer, two motor-driven pumps and a 60-ton crane. Applications for proposals should refer to Schedule 210. H. T. B. Harris, Paymaster-General, U. S. N.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until November 13, to furnish at the navy yards, etc., at Portsmouth, N. H., Boston, Mass., Newport, R. I., New York, N. Y., Annapolis, Md., Washington, D. C., Norfolk, Va., and Charleston, S. C., a quantity of naval supplies as follows: Schedule 222—Slate, wire, electrical supplies, clock and fire alarm, etc. Schedule 223—Telephone outfit, conductor, platinum wire, electric heaters, etc. Schedule 224—Motors, etc. Applications for proposals should designate the schedule by number. H. T. B. Harris, Paymaster-General, U. S. N.

WRIGHTSVILLE, GA.—The citizens voted October 15 to issue $35,000 in bonds for water works and an electric light plant.

SOCIAL CIRCLE, GA.—At an election held recently the citizens voted to issue $16,000 in bonds for the construction of an electric light plant.

GAINESVILLE, GA.—The North Georgia Electric Company, of Gainesville, writes that it will do all its own construction work, contracting only for machinery.

OCILLA, GA.—The new municipal electric light and water plant has been completed and was accepted Oct. 9 by the City Council from the builders, J. B. McCrary & Co., of Atlanta. J. L. Thrash is superintendent.

ELBA, GA.—The large water plant of the Pea River Power Company has been completed and is now in operation. It is the intention of the company to supply the towns in this vicinity with electricity and to furnish electric energy to the street car lines in this part of the country.

POST FALLS, IDAHO.—The Washington Water Power Company is contemplating the construction of a steam plant adjacent to its electric power house.

GRACE, IDAHO.—The Telluride Power Company, of Salt Lake City has decided to construct a power plant at Grace. The water will be diverted from Bear River. The probable cost of the proposed plant is placed at $1,000,000.

GALESBURG, ILL.—At a recent meeting of the City Council the ordinance granting the People's Electric Power Company the right to erect and maintain an electric system in this city was so amended that the company will now accept the franchise.

ROCK ISLAND, ILL.—A public hearing was given at the U. S. Engineer's Office, Rock Island, October 26, for the purpose of discussing the plans of the Keokuk & Hamilton Water Power Company for water power development at Des Moines Rapids of the Mississippi River.

CHICAGO, ILL.—The Safety Wire & Cable Company, of Bayonne, N. J., has secured the contract to furnish the Department of Electricity with 25,000 ft. No. 8 conductor (duplex) paper or rubber-covered, lead encased electric light cable, and 10,000 ft. No. 10 conductor (stranded), rubber-covered and braided, flexible, electric light cable, at $7,425. William Carroll is city electrician.

ANDERSON, IND.—The Indiana Ice & Dairy Company, of this city, has incorporated with a capital stock of $30,000. The company will install an electric light plant. The directors are Edward C. Handy, O. P. Crim and others.

WHITE CLOUD, IND.—Julius Rothrock, of White Cloud, writes that William Rothrock, proprietor of the White Cloud Mills, controls the water power on Blue River, and is considering the question of developing same for electrical purposes.

FORTVILLE, IND.—The City Council has granted a 50-year franchise to the Capital Circuit Traction Company for a right-of-way through the city. The company managers states that franchises have been secured in all the cities along the circuit.

CAMBRIDGE CITY, IND.—Local capitalists are promoting a new traction line, which, when constructed, will connect this city with Hagerstown, New Castle and Connersville. Considerable right-of-way has already been secured south of Cambridge City.

ARDMORE, I. T.—The Tishomingo Light & Power Company has filed application in the District Clerk's Office for the appointment of a referee to appraise a body of land lying along the banks of Washita River, near Dougherty, which the company desires to condemn. The company will build a large hydro-electric plant on the banks of the Washita and will furnish electricity for operating cars.

ROCKWELL CITY, IA.—Plans have been prepared for a telephone exchange building for the Central Mutual Telephone Company in this city. Frank W. Griffith, of Fort Dodge, Ia., is the architect.

ATLANTIC, IA.—An election will be held November 17 for the purpose of voting upon a proposition submitted by Messrs. Ross and Judd to purchase the municipal plant for $30,000, the company to be granted a twenty-five-year franchise permitting it to use the streets for light, heat and power purposes, and also for operating an electric street railway system. The City Council has passed the two ordinances granting the company the rights asked for and calling for the election, at which the question is to be submitted to the people for final ratification.

WELLINGTON, KAN.—A. B. Cheever, city clerk, writes that the citizens voted Oct. 9 to issue $10,000 in bonds for extending and improving the electric light plant, and $30,000 for water works improvements.

CLAY CENTER, KAN.—The City Council has refused to give the Clay Center Electric Light & Power Company another franchise at the expiration of its present franchise, which will expire April 29, 1907.

MINERAL, KAN.—Charles Rains will make a definite proposition to the city of West Mineral in regard to the installation of an electric light plant. Some of the machinery has already been procured for the plant and arrangements are nearly completed for the purchase of the remainder of the machinery should the franchise be arranged acceptably to the city and Mr. Rains.

LOUISVILLE, KY.—E. K. Mack, of Preston Street, is in the market for equipment for an electric light plant for a 200-room summer resort hotel.

BOWLING GREEN, KY.—The Green River Hydro-Electric Company, of Bowling Green, will develop the water power at Lock No. 5, Green River. H. von Schon, Wayne Building, Detroit, Mich., is consulting engineer.

CALAIS, ME.—Ganong Brothers are preparing for the construction of their new power house. The firm has contracted with the Robb Engineering Company, of Halifax, N. S., to equip the building with two boilers of 150 hp each and a Corliss engine of 150 hp.

PEABODY, MASS.—The Essex Glue & Gelatine Company has commenced the construction of a large power house and boiler house at its works in this place..

WEST SPRINGFIELD, MASS.—A special town meeting will soon be held to vote on the question of making an appropriation to extend and improve the electric lighting system.

LEOMINSTER, MASS.—The Leominster Electric Light & Power Company will soon install a new engine of 250 hp to meet the increasing demands for electricity for power purposes. The new machine will cost about $3,000. C. F. Young is superintendent.

LAWRENCE, MASS.—The Pacific Mills Company has purchased a large tract of land on Water Street, on which it is said that the company will erect a large lighting and power station. It is also stated that the company contemplates operating its mills by electricity instead of water power.

NORTH ATTLEBORO, MASS.—The electric light commissioners report that they will not be able to make all the necessary improvements needed for the furnishing day service and still keep within the appropriation of $35,000. It is now thought that fully $5,000 more will be needed to complete the work

WORCESTER, MASS.—All of the electric light, power and telephone wires between the Polytechnic Institute buildings on the campus will be placed underground soon. The conduit system is nearly finished. Orders have been placed with the American Electrical Works for the telephone cables, and the General Electric Company for the lighting and power cables, which will have varnished cambric insulation.

STOCKBRIDGE, MASS.—The citizens of this place are discussing the advisability of organizing an electric light company. At a meeting held recently Charles Hull was appointed to investigate the project and to call a meeting to take final action. The electricity, it is said, will be furnished by the Berkshire Street Railway Company or from the power plant now being built by the Monument Mills Company at Glendale.

WHITMAN, MASS.—The Board of Selectmen has granted to the Edison Electric Illuminating Company, of Brockton, a franchise to set poles and string wires on Bedford Street from Temple Street to the East Bridgewater line, in order that the company might furnish electricity for lighting the town of East Bridgewater. In consideration for the franchise the company has agreed to grant the town of Whitman a discount of 50 per cent on all bills for lighting in connection with the town offices and buildings, and also to furnish electricity for operating the new fire whistle at East Whitman without charge.

SHEPHERD, MICH.—S. D. Thompson, village clerk, writes that the franchise for the proposed lighting plant has not yet been granted.

SOUTH BOARDMAN, MICH.—W. C. Blackman, of Kingsley, has purchased the electric light plant, which was burned a few weeks ago, and will rebuild at once.

LANSING, MICH.—The Detroit, Flint & Saginaw Railway Company has been reorganized and the control of the property has passed to Isaac Applebaum, of Detroit. The road will be completed from Frankenmuth to Flint.

BAY CITY, MICH.—A proposition to consolidate the east and west side plants in some central location is now being considered. The Council will be asked to make an appropriation for the purpose of investigating and securing estimates.

DETROIT, MICH.—E. R. Trowbridge, of Detroit and Chicago, Ill., is promoting a proposition for the organization of a $2,500,000 company for the purpose of building an electric railway from Muskegon to Ludington through the Oceana fruit belt. The proposed line will touch Hart and Pentwater.

KALAMAZOO, MICH.—The Grand Rapids Electric Company has filed in this county a trust deed to the Cleveland Trust Company, of Ohio, for $250,000. The company has under way two lines, one extending from Grand Rapids to Alpena, and the other from Grand Rapids to Kalamazoo. The latter line will be extended to Battle Creek, thence to Coldwater and Ohio.

CADILLAC, MICH.—The Electric Land Development Company, of Traverse City, has been granted a franchise by the Board of Supervisors to construct a dam on the Manistee River in Greenwood Township. Application has also been made to the board by the Queen City Electric Power Company for permission to build a dam across the Manistee River near the same place. W. H. Ulmer is secretary of the Electric Land & Development Company.

DEER RIVER, MINN.—Andrew Morrissey has petitioned for a franchise for an electric light plant.

ST. HILAIRE, MINN.—K. O. Gigstad, village clerk, writes that the citizens voted October 16 to issue $10,000 in bonds for the construction of an electric light plant.

WATERVILLE, MINN.—The stockholders of the Cannon Valley Telephone Company have voted to increase the capital stock from $50,000 to $100,000. The company spent $20,000 in extensions last year, and double that amount will be required to construct the new lines as planned. The company has exchanges at Waterville, Montgomery, LeSueur Center, Elysian and Janesville. It is now erecting a large building in Waterville, which will be used for its general offices.

ELK RIVER, MINN.—In order to secure necessary flowage rights for the Clearwater dam the Mississippi River Electric Company has begun condemnation proceedings in the district court, and the matter will be taken up at the November term. The company also owns the water power. at this place and Monticello. It is stated that the work of financing the enterprise has progressed to a degree which makes it assured that dams will be built across the river at Clearwater, Elk River and Monticello. The dam at Elk River will be built first.

VICKSBURG, MISS.—The Board of Mayor and Aldermen on October 15 granted an electric lighting and power franchise to H. K. Johnson and associates.

POPLARVILLE, MISS.—The Board of Mayor and Aldermen has published notice of its intention to issue bonds to the amount of $8,000 for the purpose of installing an electric lighting plant to be operated in connection with the water works.

JACKSON, MISS.—The new plant of the Jackson Electric Light, Power & Street Railway Company is nearly completed and will soon be in operation. The new plant will have twice the capacity of the present plant. The company is now replacing the present arc lighting system with the new enclosed-arc lamps.

MAGNOLIA, MISS.—Owing to a disagreement between the Board of Aldermen and the Magnolia Electric Light Company the town is temporarily without street lights. The company recently raised the price for street lamps and the proposition was met with some opposition, and up to the present time the committee appointed by the light company and that of the aldermen have not been able to come to an understanding.

BUTTE, MONT.—J. R. Wharton has filed with the Clerk of the County Commissioners an application for a franchise for a street car line in Centerville to the Speculator, Diamond and other mines.

HOLDREGE, NEB.—The City Council of this place has contracted with the new electric light company for a number of arc lamps, the contract to run for one year.

LINCOLN, NEB.—The town of University Place has grown so rapidly and the use of electricity has so greatly increased that the municipal electric lighting plant is inadequate to meet demands. The Council is discussing the question of issuing bonds to enlarge and rebuild the plant.

BUTLER, N. J.—Bellman & Sanford have secured a franchise for an electric light plant.

DEAL, N. J.—At a meeting of the Borough Council held Oct. 12 it was voted to install 25 new arc lamps on the streets of the borough.

PRINCETON, N. J.—There is a movement on foot for the extension of the Trenton, Lawrenceville & Princeton Railroad through this city and on to Kingston.

NEWARK, N. J.—Runyon & Carey, the engineers engaged by the Special Committee of Common Council to investigate the question of the practicability and advisability of establishing a municpal electric light plant, to supply the streets and public buildings with electricity, submitted their report to the committee on October 17, recommending that the plant be installed. They estimate that the first cost upon the city for the establishment of an electric light plant, capable of providing all the street and public building illumination of the city that will be required for an indefinite period; beginning with the same length of conduits that now exists,

if power house is located at Bellville it will be $832,650, and if the plant is placed at the city dock it will cost $777,000. The estimates contemplate beginning the municipal service with 2,500 arc lamps.

ROSWELL, N. M.—The Roswell Electric Light & Power Company has placed orders for new machinery for its plant. Luther Stover is local manager.

OSWEGO, N. Y.—Work has commenced on the power plant of the new Citizens Gas & Electric Company. The site chosen for the power house is the old Shenandoah mill site in East First Street, where there is an extensive water power. The company expects to expend $100,000 the first year. John C. Knight is president and general manager.

LONG ISLAND CITY, N. Y.—The Long Island Consolidated Electrical Companies, a subsidiary of the Long Island Railroad, has filed for record a mortgage or deed of trust to the United States Mortgage & Trust Company, of New York, as trustee, to secure an issue of $10,000,000 in bonds.

BROCKPORT, N. Y.—The Albion Power Company is making extensive improvements to its local plant. New boilers are to be installed and other changes made. The streets will be without light for about two weeks, as the electric service will be discontinued while the machinery is being installed.

GOUVERNEUR, N. Y.—The St. Lawrence Marble Company is operating its large mill by electricity furnished by the Oswegatchie Light & Power Company. The power company has recently installed new dynamos and erected a new transmission line from its plant at Hailesboro to the marble plant, a distance of 2½ miles.

NEW YORK, N. Y.—Le Baron B. Johnson, 120 Liberty Street, has secured the contract for the electric equipment of the addition and alterations in School 51, Manhattan Borough, for $4,498, and has also been awarded the contract for installing the electric equipment in Public School 85, Astoria, Borough of Queens, for $9,015.

CANAJOHARIE, N. Y.—The Board of Trustees has awarded the Montgomery Electric Light & Power Company the contract to furnish this villlage with street lights for a term of five years. The new contract, which commences April 15, 1907, provides for arc lamps at $50 per lamp year instead of $66.66, which was paid on the former contract, making a saving of nearly $700 per year.

MINERVA, OHIO.—Bids will be received until Oct. 29 by the Board of Public Affairs for an engine and generator. Mr. L. E. Weber is secretary of the Board.

LISBON, OHIO.—The City Council has granted the Youngstown & Ohio River Railway a franchise to construct a line crossing a number of streets in the city.

CINCINNATI, OHIO.—The Cincinnati, Newport & Covington Traction Company has received a proposition to extend its Louisburg line to Erlanger. Property owners offer to give the right of way.

CLEVELAND, OHIO.—The Eastern Ohio Traction Company is making improvements costing about $75,000 on its track and overhead equipment. Tracks through Cleveland Heights Village and Chardon are being practically relaid and considerable new overhead is being installed.

STEUBENVILLE, OHIO.—The Tri-State Traction Company is planning to establish a power house near Follansbee to provide for the demands of the new electric line and to supply electricity for lighting the village of Follansbee. Equipment for the new plant is now being ordered.

TOLEDO, OHIO.—The Board of Public Service has awarded the contract to the Toledo Railway & Light Company for furnishing street lighting to the city for a term of ten years, at $45 per arc lamp per year. Under the new contract, which begins Jan. 1, 1907, the city will save $36 per year on each lamp.

MARION, OHIO.—Alfred M. Shaw, M. J. O'Donnell, F. J. Welch and John W. Moore, of Cleveland, have applied to the City Council for a franchise to construct a conduit system electric light and power plant in this city at a cost of $150,000. The city is now furnished electric energy by the Columbus, Delaware & Marion Railway Company.

GREENVILLE, OHIO.—The Board of Trade of Greenville, is endeavoring to induce the Indiana, Columbus & Eastern Company to build a line from a point near Greenville to New Paris where connections will be made with a spur line that extends to Richmond. The board will secure the right of way. About 15 miles of road will be required to make connections.

CINCINNATI, OHIO.—The Cincinnati & Eastern division of the Interurban Railway & Terminal Company has been leased to the Union Gas & Electric Company, which has recently acquired the gas and lighting plants in this city, for a period of 99 years. The Interurban Railway & Terminal Company will continue to operate the line and it is stated that the lease was made in order to comply with the state law which requires consolidating gas and electric companies to acquire an electric railway.

CLEVELAND, OHIO.—The Lake Shore Electric Railway is making extensive improvements to its power system. It is installing a 2000-kw Westinghouse-Parsons turbine in its Beach Park power station, and has recently placed a contract with the Westinghouse Company for a similar unit for its Fremont power station. This will raise the capacity of each of its main stations to about 5000 kw. It will provide for the new extensions from Sandusky to Fremont, Fremont to Tiffin, Fremont to Fostoria, and willl give the company ample power to supply other lines that may desire to purchase electricity. It is already supplying two small lines with power. In order to improve the through service additional 400-kw rotary converters are being installed in several of the sub-stations which at present have only 250-kw rotaries, and new transformers and switchboard apparatus are placed in a number of the stations.

OKLAHOMA CITY, OKLA.—The Pioneer Telephone Company is contemplating the erection of a new building in this city.

WOODWARD, OKLA.—An election will soon be held to vote on the proposition to issue bonds for $150,000 for an electric light plant.

IONE, ORE.—A municipal electric light plant is to be installed in this place at a cost of $4,000.

ROSEBURG, ORE.—The City Council has granted water and light franchises for 50 years to A. Welch, president of the Willamette Valley Company.

MARSHFIELD, ORE.—Seymour H. Bell, of Ontario, Ore.; Henry Hewitt, Jr., of Tacoma, Wash., and L. J. Simpson, of North Bend, Ore., are interested in the construction of an electric plant here to cost about $250,000.

PORTLAND, ORE.—The St. Helens Public Service Company, which is engaged in the preliminary work for the construction of the St. Helens Loop Line, is now finishing up the preliminary prospectus on the project, and will soon be ready to confer with capitalists regarding the matter of finances for the road. The Loop Line is 200 miles long. A 50-mile section is first planned. The company has a right of way already secured from Vancouver around St. Helens and returning upon the county roads; also has secured some 40 miles of private right of way. It has franchises for all the public utilities in Vancouver, La Center, Woodland, Kalama, Kelso, Castle Rock and Silver Lake, good for fifty years, without any restrictions as to when work shall begin. The chief engineer is George W. Lilly. The consulting engineers are Kelsey & Young, of Salt Lake. The company owns some 30,000 hp to 50,000 hp in water, which will be developed as a part of this scheme, and upon which preliminary work is now being done.

MILTON, PA.—The Lewisburg, Milton & Watsontown Passenger Railway Company is preparing to build an extension to Lewisburg from its present terminal at East Lewisburg, a distance of about one and a half miles.

OXFORD, PA.—The construction of the Oxford, Cochranville & Parkesburg Electric Railway has begun under the direction of Contractor Thomas E. O'Connell, who is also the promoter of the line. The road will be 14 miles in length and follow the old Limestone Road.

POTTSVILLE, PA.—The Edison Illuminating Company has secured the contract for lighting the streets of the borough for ten years at $60 per lamp per year. The magnetite lamp will be used. The terms for the installation of incandescent lamps and the maintenance of same is $18 for 32 cp and $23 for 50 cp.

SOUTH BETHLEHEM, PA.—The Blue Mountain Electric Company, recently chartered to supply the townships of Bethel, Millersburg, Strasstown and Rohrersburg with electricity for heat, light and power, has awarded the contract for the construction of its plant to cost from $8,000 to $10,500. H. C. Stombaugh is president.

BOYERSTOWN, PA.—A. V. Arrowsmith and K. A. Fichthorn, of Reading, who recently purchased the charter of the Boyerstown Heat, Light & Power Company have received permission to erect poles, string wires and furnish electricity. The company proposes constructing an electric plant and furnish electricity for lamps and motors in Boyerstown and surrounding territory.

ALTOONA, PA.—The Juniata Water Power Company and the Juniata Hydro-Electric Company will soon complete their first hydro-electric plant on the Juniata River west of Huntingdon. The total capacity of the system will be 20,000 hp. A transmission line will be erected from Lewistown to Altoona, connecting Tyrone, Huntington, Mount Union and other towns requiring electricity for lighting, electric railways and manufacturing purposes.

SHENANDOAH, PA.—Letters patent have been received at the Recorder's office chartering the three large corporations of Shenandoah under one head, to be known as the Shenandoah Light, Heat & Power Company. The concerns in the merger are the Shenandoah Gas Company, the Shenandoah Electric Illuminating Company, and the Shenandoah Heat & Power Company. The new company will meet in a few days when a Board of Directors and a manager will be elected. It is proposed to make a number of improvements to the various plants. With the steam, gas and electric light under one control it is expected that the town will be given a cheaper and better service.

HARRISBURG, PA.—The United Traction Company will expend a large amount of money in the vicinity of Reading within the next year in extending its lines, changing its Boyertown Road and building a new power plant on the west bank of the Schuylkill River. The gap between Womelsdorf and Myerstown, surveys for which have been made, will be closed, giving the company a continuous line from Reading to Palmyra, Lebanon County. The Hamburg Road is also to be built. When the extension from Boyertown to Ringing Rocks Park, near Pottstown, is completed the company will have a through line to Chestnut Hill, Philadelphia. The electric power will be furnished from the Reading end of the line by means of transformers.

GARY, S. D.—The Citizens' Electric Company has been granted a franchise in this town.

ALGOOD, TENN.—The Algood Electric Light Company is installing an electric light plant here. The officers are: W. G. Pennock, president; J. A. Epperson, vice-president; C. H. Rickman, treasurer.

HYRUM, UTAH.—Soren Hanson, of Hyrum, will probably build a power plant on Blacksmith Fork River in Cache County.

OAK GROVE, VA.—The citizens of this place are considering the construction of a municipal electric light plant to cost about $30,000.

NORFOLK, VA.—The Southern Bell Telephone Company has been granted permission to lay conduits through the business and residence section of the city.

SOUTH BOSTON, VA.—The South Boston Electric Light & Power Company is making arrangements for the development of the water power at Hyco Falls, eight miles distant.

NORFOLK, VA.—L. Feuerstein and others, of this city, will erect an ice and cold storage plant. The machinery will be operated by electricity, for which a complete plant will be installed. The estimated cost of the plant is $100,000.

RICHMOND, VA.—No bids were received October 15 by the Committee on Light of the City Council for lighting the city for a period of 1, 2, 3 or 5 years from July 1, 1907, with 800 arc lamps. New bids will be received November 1 by W. P. Knowles, superintendent city gas works.

LYNCHBURG, VA.—The town will soon have ready for distribution complete plans of the proposed municipal electric light plant. The City Council proposes, if the plant is installed, to use a part of the present pumping station, and, with the gravity system in operation, it will require only the machinery to have everything ready for supplying the electricity.

BLACKSBURG, VA.—The Blacksburg Power & Supply Company has placed an order for the first installment of machinery for its new manufacturing plant. This company was organized in September with D. H. Keister, president; J. F. Evans, vice-president; M. F. Slusser, secretary and treasurer. The purpose of the company is to manufacture ice, furnish light to the town, build a cold storage and install a system of water works.

ASOTIN, WASH.—The City Council has under consideration the installation of additional street lamps.

SPOKANE, WASH.—Plans have been made for a central exchange office for the Home Telephone Company, to cost $60,000. It will be of reinforced concrete construction. Albert Held is the architect.

TACOMA, WASH.—The Pacific Traction Company will make an application to the City Council of Steilacoon for a franchise for an electric railway through the town. The Tacoma Railway & Power Company announces that surveying on the Steilacoon branch of its American Lake line will begin in the near future.

SEATTLE, WASH.—The Seattle Electric Company is preparing to make immediate application for franchises for use of streets which will extend its car system fifteen miles within the city limits and will require the construction of 21 miles of track. This is in addition to the franchise application for Second Avenue north and Westlake boulevard. With the improvements under way and the work contemplated the company will expend more than $1,000,000 within the next 18 months.

WOODLAWN, W. VA.—The Home Electric Company has secured the contract for the installation of the power plant for the Woodlawn Hotel Company.

WESTFIELD, WIS.—The Westfield Milling & Electric Light Company has increased its capital stock from $30,000 to $40,000. Julius Warnke is president.

SUPERIOR, WIS.—E. B. Banks, City Engineer, writes that it is proposed to construct municipal electric light plant, at a cost of $100,000. No engineer has been engaged as yet. Victor Linley is Mayor.

SUPERIOR, WIS.—The City Council voted October 16 in favor of a municipal lighting plant, either by purchasing the plant of the Superior Water, Light & Power Company or erecting a new plant. The sum of $1,000 was allowed for initial expenses for investigating the project.

GREEN BAY, WIS.—Bids will be received until November 23 by the Commissioner of Indian Affairs (H. F. Larrabee, Acting Commissioner, Washington, D. C.), for furnishing material and constructing an electric light plant at the Green Bay School. For further information apply to Shephard Freeman, superintendent.

THERMOPOLIS, WYO.—Fred. W. Hart, a hydraulic engineer, of Denver, Col., is preparing plans for a large power plant to be constructed by the Asmus Boysen Company in the Big Horn Canon near here. The plant will cost about $250,000.

DAWSON, B. C.—The Canadian-Klondike Company, Ltd., is contemplating the installation of a large power plant in the Twelve Mile district at a cost of $600,000. Three large Pelton water wheels will be installed, and transmission lines will be erected to the company's present plant at the mouth of Bear, a distance of 35 miles. The company will, next season, also install three more dredges of the Marion type. The dredges and the power system will entail an expenditure of about $1,500,000. Material for the plant has not yet been ordered. Sigmund Rothschild is president.

GUANTANAMO, CUBA.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until November 13, to furnish at the naval station Guantanamo, Cuba, a quantity of electrical supplies, etc. Application for proposals should refer to Schedule 228. H. T. B. Harris, Paymaster General, U. S. N.

KENORA, ONT.—The lawsuits in connection with the civic power project have been awarded in favor of the town and the plant will be constructed at once. It is expected about 6,000 hp will be available by Jan. 1, 1907. Address Mayor Carmichael.

ST. LOUIS, QUE.—The Town Council has awarded to the Montreal Light, Heat & Power Company, of Montreal, the contract for replacing the present gas lamps with incandescent lamps at $7.50 each for making the change and $22 per year for each lamp.

WEST SHEFFIELD, QUE.—Messrs. Horner and Watson are installing an electric plant in West Sheffield and will soon be ready to furnish electricity for lighting the streets and residences of the village.

COLONIAS, MEX.—A street railway system is to be built at Colonia by local capitalists.

MATEHUALA, MEX.—The Negociacion Minera Santa Maria de la Paz y Anexas of Matehuala will install a steam-driven electric plant in its mines.

EL ORO, MEX.—Otway Norwood is preparing to install an electric power plant and transmission system on the Nazas River near El Oro, state of Durango. The transmission lines will run to several towns and industrial centers of this section where the electricity will be used in operating machinery and for lighting purposes.

MEXICO CITY, MEX.—The Federal Government has granted a concession to the Schoendube & Neugebauer Company to install a large hydro-electric plant on the Concho River in the Iturbide district, state of Chihuahua. Preparations for the early construction of the plant and transmission lines are now being made. The electric power will be transmitted to a number of towns and industrial concerns in the state of Chihuahua.

GUADALAJARA, MEX.—The deal for the purchase of the extensive holdings of La Electra, S. A., and the Company Industrial de Guadalajara, in this city, by the Mexican Light & Power Company, the Canadian concern which owns the electric power transmission plant at Necaxa and the street railway systems of Mexico City and Puebla, has practically been completed. The consideration is said to be upwards of $5,000,000 The property includes the electric lighting plants and street railway systems of the two companies. The Mexican Light & Power Company was represented in the transaction by Frank Thomason and W. F. Tye, of Montreal, and R. F. Hayward, manager for the company in Mexico City. It is announced that extensive improvements will be made to the existing systems.

CANANEA, MEX.—One of the largest electric power and transmission plants in Mexico is to be installed on the Aros River at a point about 150 miles from Cananea by Col. W. C. Greene, of New York, N. Y. Engineers are now making a survey for the proposed plant. The primary object of the project is to afford electric power for operating the mines, smelter and other industrial concerns of the Greene Consolidated Copper Company at Cananea, and his large lumber mills and paper factory in the Sierra Madre region of the State of Chihuahua. The Cananea transmission line will be about 150 miles long while the transmission line which is to be built to Dedrick and other places where the lumber mills are located will be more than 200 miles long. It is also planned to build transmission lines to Hermosillo, the capital of the state, and to a number of towns where there are large mines and smelters in operation. It is stated that several million dollars will be expended in this enterprise.

Company Elections.

EVANSVILLE, IND.—The directors of the Evansville Gas & Electric Light Company have elected the following officers: H. D. Walbridge, New York, N. Y., president; R. K. Dunkerson, Evansville, vice-president; W. D. McDonald, Evansville, second vice-president and general manager; J. F. Haas, Evansville, secretary-treasurer.

COFFEYVILLE, KAN.—The Coffeyville Transit Company has elected officers for the ensuing year as follows: Charles Etchen, president; W. H. Shepard, vice president; L. L. Bingaman, treasurer, and A. R. Wilson, secretary. The company has purchased the old McGuire and Stanton franchise, and will operate to Forest Park.

SYRACUSE, N. Y.—At the annual meeting of the Board of Directors of the Syracuse Lighting Company held October 18 the present officers were re-elected: John J. Cummins, president; Henry Seligman, of New York, N. Y., vice-president; Albert K. Hiscock, treasurer; Louis L. Waters, secretary; Horace White, attorney.

HOLYOKE, MASS.—At the annual meeting of the Holyoke Water Power Company held Oct. 17, the following directors were elected: Charles E. Gross, Charles N. Beach, Rev. Francis Goodwin, D. W. C. Skilton, of Hartford, Conn.; James J. Goodwin, of New York, N. Y.; L. Clarke Seelye, of Northampton; Levi L. Willcut, of Boston; Frederick Harris and A. W. Damon, of Springfield. The directors elected Charles E. Gross president.

ROCKFORD, WASH.—At a meeting of the Spokane County Electric Company held recently the following officers were elected: D. L. Huntington, of Spokane, president; H. L. Bleecker, of Spokane, vice-president; H. W. Collins, of Rockford, secretary, treasurer and manager. The company was recently incorporated and the main office will be at Rockford. The company will furnish electricity for light and power to towns in the southeastern part of the county.

New Industrial Companies.

THE WASHINGTON MOTOR CAR COMPANY, of Washington, Ind., has been incorporated with a capital of $160,000. Frank W. Fowler is president.

THE NEWARK ARC LAMP COMPANY, of Newark, N. J., has filed articles of incorporation with a capital stock of $10,000. The incorporators are Charles L. Beck, Charles O. Geyer and F. C. Ferguson.

THE CORWIN TELEPHONE MANUFACTURING COMPANY, of Chicago, Ill., has filed articles of incorporation with a capital stock of $4,000 to manufacture and deal in electrical supplies. The incorporators are: Fred L. Meckel, Frank X. Cloide and Elmer R. Corwin.

THE NEW CASTLE ELECTRIC SIGN COMPANY, of New Castle, Ind., capitalized at $20,000, recently incorporated, is preparing to build a plant to manufacture electric signs and electrical advertising devices. The directors are William H. Alford, James M. Dumas and H. W. Bolson.

THE MONARCH IRON WORKS, of Plymouth, Ind., has filed articles of incorporation with the Secretary of State. The capital stock is $50,000. The company proposes to construct and equip a plant to do a general foundry, electrical machinery and mechanical engineering manufacturing business. James B. Beattie is president.

THE CURRENT MOTOR COMPANY OF GEORGIA, of Atlanta, Ga., has filed an application for a charter through E. F. Peckham, H. E. Tolman, A. Madison, W. J. Fletcher and J. H. Tolman. The company will be capitalized at $1,000,000 with the privilege of increasing the amount. It is proposed to deal in electrical appliances and to equip and operate power and light plants.

THE NEW YORK POWER SECURITIES COMPANY, of Buffalo, N. Y., has filed articles of incorporation to carry on the business of electrical, mechanical and civil engineers and contractors. The company has a capital stock of $2,500,000. The directors are: William K. McFarlin, East Orange, N. J.; John Boyd Thatcher, Albany, N. Y.; Arthur Robertson, New York, N. Y.; Herbert P. Bissell, Irving L. Fisk and Chauncey J. Hamlin, of Buffalo, N. Y.

New Incorporations.

MONTGOMERY, ALA.—Articles of incorporation have been filed for the Muscle-Shoals Hydro-Electric Power Company with a capital stock of $1,000,000 by Frank S. Washburn, of Nashville, Tenn.; Charles H. Baker, of New York; William H. Lindsey, Nashville, Tenn.; J. W. Worthington, of Sheffield, Ala., and Massey Wilson, of Montgomery, Ala.

RAGLAND, ALA.—The Ragland Water Power Company has been incorporated with a capital stock of $5,000 by W. T. Brown, A. L. Fullenwider and Ross C. Smith.

PHOENIX, ARIZ.—Articles of incorporation have been filed with the Secretary of State by the Lake Chelan Water Power Company with a capital stock of $3,000,000. The incorporators and officers are: James McMillan, of Minneapolis, Minn., president; James Bebee, of Wakefield, Mass., vice-president; Albert F. Hellwell, of Minneapolis, Minn., secretary and treasurer, and Carrie E. McMillan and Charles F. Linnmayer, of Minneapolis, Minn. The chief place of business is at Phoenix, Ariz., with branch offices at Chelan, Wash., Boston, Mass., Minneapolis, Minn., and New York, N. Y.

REDDING, CAL.—The Pacheco Telephone Company has been organized by the farmers living on Churn Creek. D. W. Hampton is president of the company.

WATERLOO, IA.—The Iowa & Northwestern Railway Company has been incorporated with a capital stock of $100,000 to construct, purchase, operate and sell railways which may be operated by steam, electric or other motive power. The board of directors and officers are: Stephen B. Howard, president; Edward M. Rice, vice-president, and Edward C. Luther, secretary and treasurer.

DES MOINES, IA.—The American Electric Railroad Company has filed articles of incorporation with the Secretary of State with a capital stock of $20,000. C. W. Baker is president; J. D. Pollard, vice-president and treasurer, and Charles F. Castleman, secretary, all of Des Moines.

SAND POINT, IDA.—The Sandpoint Citizens Water, Light & Power Company has been incorporated, with a capital stock of $150,000. The incorporators are George Heaton, Robert Coons and others.

SULLIVAN, ILL.—The Diamond Mutual Telephone Company has been formed in this city by Irving Shuman, J. R. Bern and others.

ROCK, ILL.—Articles of incorporation have been filed for the Simpson Mutual Telephone Company, with a capital stock of $5,000. The incorporators are John R. Harper and others.

FISHER, ILL.—The Fisher Telephone Company has filed articles of incorporation, with a capital stock of $5,000, to construct and operate a telephone system. The incorporators are William H. Swayzee, George W. Robinet and Joseph K. Waddington.

HAMMOND, ILL.—A new company is being formed by T. E. Bell, of this city, and others, which will be known as the Harrisburg & Ohio River Electric Railroad Company, for the purpose of promoting a new electric railway to connect towns in Southern Indiana and Illinois. The line will be 42 miles long.

CHICAGO, ILL.—Articles of incorporation have been filed with the Secretary of State by the Chicago, St. Louis & Kansas City Electric Railway Company to construct and operate an electric railway. The capital stock is $2,500. The incorporators are S. M. McDonald, Thomas W. Kenyon and John C. Corey.

ST. JACOBS, ILL.—Articles of incorporation have been filed with the Secretary of State by the Home Telephone Company, with a capital stock of $10,000, to operate a telephone exchange. The incorporators are Chris Busse, Frank Virgin and John L. Knoll.

WATERLOO, ILL.—Incorporation papers have been filed in the Circuit Clerk's office by the East St. Louis, Columbia & Waterloo Railway Company, which will build an electric road from East St. Louis to Columbia and Waterloo, through St. Clair and Monroe counties. The charter is for fifty years. The main office will be at Columbia. The incorporators and first board of directors are J. W. Warnock, E. E. Schoening, Henry Reichenbach, J. M. Armin and others.

CAMBRIDGE, MD.—Articles of incorporation have been filed by the Hoopers Island & Golden Hill Telephone Company to construct a telephone line through Hoopers Island to Golden Hill, and may construct lines from Hoopers Island to other points in Dorchester. The capital stock is $2,500. The incorporators are William F. Applegarth, Charles R. Mills, Henry A. Phillips, George W. Tyler, John M. Clayton, Alonzo Travers, Oscar A. Keene, John S. Boseman and Benjamin F. Travers.

PORTLAND, ME.—The Genessee County Niagara Power Company has filed articles of incorporation with the Secretary of State with a capital stock of $250,000 for the purpose of promoting or carrying on the business of an electric light and power company. The officers are: W. F. Crummett, president, and Charles D. Fullerton, treasurer, all of Portland.

STARKVILLE, MISS.—The Starkville Street Railway Company has been organized with R. K. Weir as president; T. B. Carroll, vice-president, and Wirt Carpenter, secretary and treasurer.

JEFFERSON, MO.—The Missouri Interurban Railroad Company, of Sedalia, has filed articles of incorporation with the Secretary of State with a capital stock of $20,000. The company proposes to build a railway from Sedalia to Jefferson City, a distance of 80 miles. The line has been surveyed and most of the right of way secured. Among the incorporators are J. W. Meltor, W. B. Meyers, J. D. Stark, C. W. Thomas, Henry Frick and others.

LIVINGSTON, MONT.—The Livingston Home Telephone Company has been incorporated with a capital stock of $60,000.

NEW YORK, N. Y.—Articles of incorporation have been filed for the Zanzibar Telephone Company, with a capital stock of $5,000, by J. A. Jones, W. D. Despard and F. W. Vining.

NEW YORK, N. Y.—The American Water Power Company has filed articles of incorporation with a capital stock of $100,000. The directors are William H. Pritchard, Phelix G. Wezel and E. J. Selley, of New York, N. Y.

PATTEN, N. Y.—The Patten & Trout Brook Telephone Company has filed articles of incorporation with a capital stock of $3,500. B. W. Howe is president.

TROY, N. Y.—Articles of incorporation have been filed for the New York & Vermont Telephone Company with a capital stock of $100,000. The company proposes to operate telephone lines in Rensselaer, Warren, Saratoga, Washington and Essex counties. The directors are W. Levis Burk, W. C. Colburn, James H. Caldwell, I. S. Freeman, Williams Commors, of Troy; Clarence E. Parker, H. J. Stevens, Floyd E. Cole, of Granville, and W. L. Hitchcock, of Cambridge.

NEW WESTON, OHIO.—The New Weston & Rossburg Telephone Company has filed articles of incorporation with a capital stock of $20,000. The incorporators are W. D. Rush and others.

SALEM, OHIO.—The Forde Light Company has been incorporated with a capital stock of $30,000 by L. H. Kirkbridge and others.

Legal.

CENTRAL STATION CONSTRUCTION.—At St. Louis, Mo., the American Bridge Company, of New York, has filed suit in equity in the United States Circuit Court against the Union Electric Light & Power Company of that city for $158,334. The plaintiff states that it has had various contracts with the Union Electric Light & Power Co. for the construction of a plant, amounting to $766.651 on which it received $629,875. It sues for the alleged balance and $21,648 for additional expenses. The plaintiff asks that a master in chancery be appointed to make an accounting of its transactions with the lighting company and report the findings. N. P. G. Coates, secretary of the Union Electric Lighting & Power Company said that the suit arose over amounts in dispute on various contracts for the Ashley street station. He asserts that owing to delays, etc., the American Bridge Co. is in reality indebted to the lighting company about $350,000.

AN EDISON FORMULA.—Mr. Thomas A. Edison was a witness before Vice Chancellor Stevens in Newark, on October 18, in a suit he has brought to restrain the Edison Polyform and Manufacturing Company from using his photograph and name on the labels of a patent liniment manufactured and sold by it. He also asks for the income and profits alleged to have been unlawfully derived by the use of his name. Mr. Edison testified that while suffering from neuralgia at Menlo Park in 1879 he mixed a preparation which gave him relief. He recommended it to Charles H. Lewis, a friend, of Camden, Me., who offered to buy the formula for $5,000. On May 13, 1903, according to complainant's bill, Wilbur L. Beaty, George J. Meier, of Chicago, and J. Tracy Morton, of Newark, organized the defendant corporation to carry on the manufacture and sale of the liniment. The defendant concern, in its answer, says it received an assignment of the formula from Lewis and produced a certificate stating that the formula was devised by the complainant. Mr. Edison disclaims authorship of the certificate, and he said that he had recommended it to Lewis with the understanding that it was not to be put upon the market. He applied for a patent, but had never received one. The complainant also asserts that the materials used in the formula are too expensive to be put on the market, and he charges the defendant with deception and fraud.

Obituary.

B. H. WARREN.

MR. BENJAMIN H. WARREN.—We record with deep regret the sudden death from apoplexy at the Hotel Collingwood, New York City, of Mr. Benjamin H. Warren. He was found dead on the floor of his room partially dressed, after having spent the previous evening at the Engineers' Club, one of his favorite haunts, where he had dined with his brother, Mr. Arthur Warren. The son of an officer who was killed early in the Civil War, Mr. Warren graduated in the engineer corps at the United States Naval Academy in 1874, and was in active service in the United States Navy at sea and on shore until 1878, when he resigned from the service to find larger opportunities for his energies. From 1878 until 1890 he was with the Hancock Inspirator Company, Boston, Mass., as mechanical engineer, manager of the London office four years, and as superintendent six years. From 1890 to 1895 Mr. Warren was manager of the hoisting and pulley block department at the Yale & Towne Manufacturing Company, Stamford, Conn. He went thence, when the business of that department was sold, to the Pratt & Whitney Company, Hartford, Conn., serving temporarily as assistant secretary and treasurer. Mr. Warren was next, from 1896 to 1902, with the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., as assistant general manager, in charge of manufacturing for ten months, then as second vice-president, in charge of both the manufacturing and the commercial branches of the business. After a brief interval, Mr. Warren was appointed president of the Allis-Chalmers Company, and he remained in that capacity until the growing burdens overtaxed his health, whereupon he resigned. He then formed an engineering firm in this city with two old friends, Capt. John C. Kafer and Mr. A. M. Mattice, and upon the death of the former continued in the practice of his profession with Mr. Mattice. He was a member of the American Society of Mechanical Engineers, the Engineers' Club, the University Club and a number of other kindred bodies. Mr Warren leaves a wife, son and two daughters. His home was at Albeiene, Virginia.

Personal.

MR. F. H. KROGER has been appointed instructor in electrical engineering at Cornell University.

MR. LUDWIG GUTMANN, the electrical engineer, of St. Louis, Mo., has just returned from a European trip, via Hamburg. He met a great many old friends and acquaintances abroad.

PROF. GEORGE C. SHAAD, of the University of Wisconsin, has been appointed associate professor of electrical engineering at the Massachusetts Institute of Technology.

MR. RUDOLPH P. MILLER, C. E., until recently chief engineer, Bureau of Buildings, New York City, has opened an office as consulting engineer at 527 Fifth Avenue, New York.

MR. ALBERT UHL, who was formerly the representative of the Woods Electric Company, of Houston, Tex., in Oklahoma, is now permanently located at the home office in charge of the sales and apparatus department.

MESSRS. J. B. NEWHALL and P. G. Watmough, Jr., hydraulic and electrical engineers, of New York City, have been engaged by the Colabaugh Water Company to design and supervise a system of water works at Croton-on-Hudson.

MR. C. T. MALCOLMSON, the engineer in charge of the U. S. coal testing plant at St. Louis, has been visiting the East. He reports the intention to establish a similar plant in connection wih the Jamestown Exposition, under favorable conditions as to useful results.

MR. C. H. DUELL, justice of the Court of Appeals of the District of Columbia, and formerly U. S. Commissioner of Patents, has resigned from the bench to resume active practice at the patent bar, with which he was so long connected. He has joined and become a partner in the firm of Duell, Warfield & Duell, of 60 Wall Street, New York City.

MR. A. J. FERGUSON, of Hansons & Ferguson, on his arrival at Montreal from Rio de Janeiro, said that the Rio de Janeiro Tramway, Light & Power Company is ready to deliver 3,500 hp from a temporary plant, and that the plant under construction from which 48,000 hp will be secured will be in operation within fifteen months. There is an immediate market for all the power the company will have available.

BUTTENHEIM—STODDARD.—Mr. Harold S. Buttenheim and Miss Margaret E. Stoddard, daughter of William O. Stoddard, the author, were married on October 9th at the home of the bride's parents at Madison. N. J. Mr. Buttenheim is the secretary of the McGraw Publishing Co., and business manager of *The Street Railway Journal*. The happy pair are spending the balance of the month in Bermuda and will make their home in Madison upon their return.

MR. F. E. ANDERSON, having resigned as electrical superintendent of the Toledo & Western Railway, that office is abolished. Mr. Ira Scofield has been appointed superintendent of motive power and equipment in charge of shops, electrical and steam equipment, and will report to the receiver and general manager. Mr. Wm. Denton has been appointed engineer of the power station in charge of the power station and power station employees, and will report to the superintendent of motive power and equipment.

MR. J. S. WEBSTER, of 113 North Sixth Street, Minneapolis, Minn., is preparing plans and specifications for the electrical equipment of a large wholesale building now under course of construction in that city. This building will have over a half million square feet of floor space and the connected lighting load will amount to over 200 kw. There will be over 400 hp in electric motors. Pamphlets describing the latest material for open and conduit work, panel boxes, switchboards, switches, etc., will be appreciated. A portion of the equipment will be for over 2,000 volts alternating current.

MR. FRANK H. BROWN, district superintendent of the Public Service Corporation, of Elizabeth, N. J., has accepted a position as division superintendent of the Pawtucket Street Railway system of the Rhode Island Company. Mr. Brown fills the position made vacant by the resignation of Mr. Raymond R. Smith, who went to Evansville, Ind., last July. Mr. Brown was born in Providence, and was educated in the public schools of that city He started in the railroad business in Worcester, Mass., fifteen years ago last February, as a conductor. He was promoted to the car house, where he was in charge, later going to Elizabeth, N. J., as an inspector and working his way up until he became district superintendent.

Trade Publications.

DIRECT-CURRENT MOTORS.—The Robbins & Myers Company, Springfield, Ohio, has issued bulletin No. 51, dealing with direct-current motors for 110, 220 and 500 volts, rated at from ¼ to 15 hp.

ENCLOSED FUSE DEVICES.—A complete price list with illustrative descriptions of "Noarc" enclosed fuse devices is to be found in catalogue No. 400, recently issued by the H. W. Johns-Manville Co., 100 Williams St., New York.

ELECTRIC NOVELTIES.—Catalogue No. 17 of the Kapp Electric & Novelty Company, 511 West 51st Street, New York, describes numerous electric specialties, including miniature motors, dynamos, electric fans, electric locomotives, trains and trolley cars.

RAILWAY MOTORS.—Bulletin No. 1053 of the Allis-Chalmers Company, Milwaukee, Wis., gives a well-prepared illustrated description of railway motors and controllers. The motors treated are rated at 35, 50 and 75 hp, the e.m.f. in each case being 500 volts.

"LATEST SPECIALTIES."—H. T. Paiste Co., Philadelphia, Pa., in its October bulletin, "Latest Specialties," gives attention to Fielding receptacles, window lighting, cartridge cut-outs, and revised prices on same. The circular is a handsome one, full of cuts and data, and should be seen for the latest quotations.

AIR COMPRESSORS.—The Chicago Pneumatic Tool Company, Chicago, Ill., has issued a booklet showing some of the users of Franklin air compressors throughout the world. On account of the fact that the names are arranged geographically by countries, states, towns, and in case of those using two or more, the exact number installed at each point is stated, the publication forms a handy reference book for those desiring to investigate the various installations in their locality.

News of the Trade.

THE JEFFREY MANUFACTURING COMPANY, Columbus, O., has established a new Canadian branch office in Montreal, Canada, at Lagauchetiere and Cote Streets.

THE LOMBARD-REPOGLE ENGINEERING COMPANY has announced that its new commodious building in the center of Akron, Ohio, will be ready for occupancy during the present month. This building, which is located on West Market Street, where it crosses the viaduct, consists of seven stories and has over 100,000 sq. ft. of floor space. This company will manufacture the Lombard-Repogle water-wheel governor.

THE BRISTOL COMPANY, of Waterbury, Conn., has established a branch office at 753 Monadnock Building, Chicago. It will be able to fill rush orders, that often crop up, particularly for instrument supplies in the gauge and recorder line, thus saving several days in delivery. The representatives on the spot will moreover be able to offer helpful suggestions as to the operation of Bristol recorders, as well as full information about new types and ranges.

CHASE-SHAWMUT COMPANY.——One of the latest improvements of the Chase-Shawmut Company, Newburyport, Mass., is the packing of its National Electrical Code fuses from 100 amp. up, in separate cartons. This enables the fuses to be handled much more readily and makes a very neat display in the jobbers store-room. We believe that this will be a pleasing feature to the trade. The new 100 amp. porcelain cut-outs, both "DP" and "TP," which have recently been placed on the market by the same company, are very attractive, and will fill a long felt want. They are neatly packed in separate cartons and can be handled very readily.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 16, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

833,152. CIRCUIT CLOSER; Walter B. Bielak, Gresham, and Barney W. Belock, Cleveland, O. App. filed July 14, 1906. The rail is recessed with a vertical slot from which a pivoted tappet projects upwardly so as to be displaced in one direction or the other by the passage of a train to close an appropriate alarm circuit.

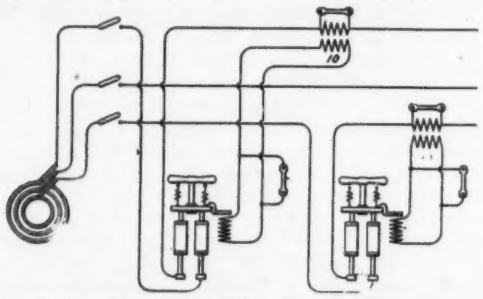
833,159. RELAY ATTACHMENT AND ALARM FOR TELEPHONE SYSTEMS; Charles A. England, Van Meter, Ia. App. filed Nov. 13, 1905. A relay attachment for telephone system, comprising a shell, a cap hinged to the shell, a lever carried by the cap and projecting outwardly therefrom, a pair of spaced L-shaped arms having their horizontal portions secured to the side of said shell and having their vertical portions disposed in the path of movement of said lever.

833,169. MAGNETIC ORE SEPARATOR; Camden E. Knowles, Joplin, Mo. App. filed Dec. 5, 1901. A continuously moving belt is studded with iron projections and passes between a pair of pole faces. The ore particles are carried by the belt and are deflected into one or another channel by the magnetized studs.

833,178. MEANS FOR OPENING AND CLOSING ELECTRICAL CIRCUITS; Gustaf Rennerfelt, Scranton, Pa. App. filed June 11, 1904. A circuit breaker designed to accomplish a number of purposes such as remaining closed in case of short duration overload, having it adjustable for different loads, and magnetically blowing out the arc when the switch operates.

833,194. PROTECTIVE DEVICE FOR ALTERNATING CURRENT CIRCUITS; Leonard Andrews, Manchester, Eng. App. filed Sept. 18, 1905. In order to avoid the series and shunt coils of an alternating current cut-out from acting together as a transformer so as to vitiate the action of the shunt coil, patentee has the coils arranged so that their effects are electrically rather than magnetically combined.

833,205. ELECTRIC METER; Thomas Duncan, Chicago, Ill. App. filed



833,211.—Safety System for High Tension Transmission Lines.

July 11, 1901. The watt-hour meter has a small pivoted part which can be adjusted to different positions and which produces a reaction with the eddy currents of the disc so as to produce a varying torque to compensate for different voltages.

833,207. TRANSFORMER; John J. Frank, Schenectady, N. Y. App. filed Oct. 14, 1905. In order to prevent injury to oil bath switches by evaporation of the oil, patentee has small spark gaps near the surface of the oil which are in circuit with resistances so that a shunt will be formed when the oil evaporates to a certain extent thereby giving an alarm.

833,208. DOUBLE THROW ELECTRIC SWITCH WITH INDICATOR; Edward M. Hewlett, Schenectady, N. Y. App. filed July 11, 1903. An indicating finger has a lost motion connection with the switch arm shaft, so that the finger moves only slightly to a pair of positions or marks on a stationary dial.

833,210. INTERLOCKING DEVICE FOR CIRCUIT BREAKERS; Charles H. Hill, Schenectady, N. Y. App. filed Feb. 3, 1905. A pair of circuit breakers adapted for storage batteries. Designed to open the circuit of the batteries when the dynamo fails to act, but does not open the circuit of the dynamo when the storage battery circuit opens.

833,211. SAFETY SYSTEM FOR HIGH TENSION TRANSMISSION LINES; John D. Hilliard, Jr., Glens Falls, N. Y. App. filed Apr. 20, 1904. In order to use cheap circuit breakers with very high voltages, patentee has transformers in the various branches which are normally shunted by a fuse. The secondaries of these transformers are also shunted by a fuse and include windings for operating the cut-out magnets. In case of overload the fuses blow harmlessly without drawing any considerable arc, but the impedence of the transformers rises suddenly so as to absorb the high voltage which is therefore not impressed on the switch contacts.

833,224. RECEIVING DEVICE FOR ELECTRICAL TRANSMISSION; Isidor Kitsee, Philadelphia, Pa. App. filed Mar. 25, 1905. A form of syphon recorder in which provision is made for completing circuits to a local sounder. The recorder arm has a bar thereon which moves in a special way with respect to four contacts connected in circuits so as to avoid the usual trouble of "shifting zero."

833,225. TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Apr. 14, 1905. An adaptation of the bridge quadruplex method to a sub-marine cable system.

833,226. TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed June 6, 1906. A plan for making ordinary Morse keys at points along a single line wire effective to act as pole changing transmitters. Is done by grounding high potential side of a battery which normally overpowers a weaker battery.

833,228. MOTOR CONTROLLER; William A. Lacke, Chicago, Ill. App. filed Nov. 29, 1905. Details of a contactor system in which the contactors are separately operated by slow-moving solenoids, each one being set in motion by the preceding.

833,252. COUPLING FOR ELECTRIC CABLES; Charles F. Schwennker, Schenectady, N. Y. App. filed Feb. 14, 1903. A plan for splicing together cables by soldering the cable ends into a pair of sleeves which are diagonally scarfed together and wrapped with a helical spring.

833,279. TELEPHONE-RECEIVER; Henry F. Albright, New York, N. Y. App. filed Feb. 5, 1904. Details of a telephone receiver of the ordinary bar magnet form having a special form of insulating block carrying terminals at the rear end of the instrument.

833,290. ELECTRICAL CONDUCTOR; Anson G. Betts, Troy, N. Y. App. filed Nov. 30, 1904. A sodium conductor. Patentee states that sodium conductors can be installed more cheaply than copper for equal conductivity. Coats with an iron sheathing so as to avoid oxidation and impart greater strength.

833,296. JUNCTION BOX; William F. Bossert, Utica, N. Y. App. filed Sept. 15, 1904. A knock-out box of which the weakened portions are somewhat expanded so as to be tightly engaged in the surrounding wall, whereby the box is water proof.

833,297. LOCK-OUT SYSTEM FOR PARTY-LINE TELEPHONES; William M. Bruce, Jr., Springfield, O. App. filed Oct. 5, 1905. An electromagnet at the subscriber's station is adapted to be bridged across the line and has a normally open shunt which can be closed to prevent any other magnet from being operated.

833,298. LOCK-OUT SYSTEM FOR PARTY-LINE TELEPHONES; William M. Bruce, Jr., Springfield, O. App. filed Oct. 23, 1905. Relates to modifications of the above.

833,312. TROLLEY; Andrew H. Dreijer, New York, N. Y. App. filed June 6, 1904. The tread of the wheel has a plurality of small rollers inset therein. One form of the invention has a double trolley wheel to engage a double conductor.

833,317. CUT-OUT; Henry Heisenhoner, Schenectady, N. Y. App. filed May 8, 1903. A pendant switch having a plurality of elements by which different circuits can be controlled. Has a single button release for all the circuits.

833,327. DISTRIBUTING BOX; Harry H. Hornsby, Chicago, Ill. App. filed Jan. 7, 1903. Relates to details of the mounting of the various contacts and parts of an ordinary distributing panel or board.

833,342. ELECTRIC RECEPTACLE; Bert E. Salisbury, Syracuse, N. Y. App. filed Feb. 20, 1906. A porcelain moulded part has a bayonet joint by which it is engaged in openings in a sheet iron support by an easy manipulation for electrical signs, etc.

833,353. TROLLEY WHEEL; Gustavus Troxler, Jr., Newark, N. J. App. filed Oct. 10, 1905. The trolley wheel has radially projecting spring fingers which yield in case they encounter guy wires, etc.

833,357. ELECTRIC FURNACE; Leonard Waldo, Plainfield, N. J. App. filed June 23, 1905. In an induction-furnace, having a charge-receiving chamber and an inducing-circuit for melting the charge in said chamber, means for electrolyzing said melted charge.

833,361. WAVE AND CURRENT ELECTRICAL GENERATOR; John T. Wilmore, Denver, Col. App. filed Oct. 23, 1905. A form of wave-motor having paddle wheels on floating rafts which are geared to electric generators by a form of internal gearing.

833,363. CEMENT AND PROCESS OF MAKING SAME; John A. Yates, Rosebank, N. Y. App. filed Jan. 27, 1906. The process of making cement which consists of reducing rosin to a liquid under the action of heat and forty-eight parts of marble-flour combined under the action of heat.

833,390. SPRING-JACK FOR TELEPHONE SWITCHBOARDS; Howard B. Holmes, Park Ridge, and Edward B. Craft, Chicago, Ill. App. filed June 24, 1905. A strip of spring-jacks for telephone switchboards, comprising a mounting-plate, an insulating face-strip supported thereby, and provided with test-rings for the jacks, the said rings being provided each with an extension integral therewith, in combination with jack units containing line and contact springs mounted upon said plate, said jack units being each provided with an opening or space through which the extension of its corresponding test-ring is adapted to be inserted and maintained insulated.

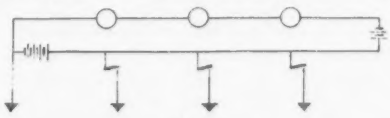
833,425. THERMAL COUT-OUT AND CIRCUIT CHANGER; Alfred O. Stigberg, Chicago, Ill. App. filed June 3, 1904. The thermal coil surrounds a spring pressed rod which is heated by the passage of an abnormal current. The rod rests against a wax disc which is softened to permit movement of the rod when heated.

833,427. MANUFACTURE OF SILICIDES AND SILICON ALLOYS; Frank J. Tone, Niagara Falls, N. Y. App. filed May 18, 1905. The process of producing alloys and compounds which consists in subjecting metalliferous material with a carbid of an element to heat sufficient to dissociate said element from the carbon and cause its combination with the metal of the charge.

833,429. AUTOMATIC SYSTEM OF INTERCOMMUNICATION; Anthony Van Wagenen, Sioux City, Ia. App. filed July 31, 1902. Details of an automatic telephone system having automatic switch boards with circular contacts and arms which are stepped around to engage the same.

833,465. ELECTROTHERMOSTATIC FIRE ALARM; Jesse M. Knowles and Silas A. Gregory, Stockport, Ia. App. filed Feb. 26, 1906. A circular box has a diaphragm connected with a pivoted arm. The arm oscillates between fixed contacts so as to complete alarm circuits for both high and low temperature conditions.

833,505. TROLLEY; Henry B. Burke, Windber, Pa. App. filed Dec. 28,



833,226—Telegraphy.

1905. The trolley harp is formed of zigzag prongs on each side so that the wheel is more resiliently supported against the wire.

833,513. MANUFACTURE OF HYDROAZO DERIVATIVES; Otto Dieffenbach, Darmstadt, Germany. App. filed Mar. 28, 1906. The hereindescribed manufacture of hydrazo derivatives by the electrolytic reduction of the corresponding nitro, azoxy and axo bodies suspended in an aqueous alkaline solution, which consists in adding a convenient solvent insoluble in water to the electrolyte, in order to dissolve the reduction products obtained by the electrolysis, thereby preventing the said products from depositing in a solid form and facilitating their removal from the cathode compartment.

833,550. TROLLEY HARP; William K. Richardson, Leavenworth, Kansas. App. filed Sept. 1, 1905. The trolley wheel is journalled on a stationary axle and spring blades are removably interlocked on studs within the harp so as to make a good connection with the wheel.

833,556. INCANDESCENT LAMP SOCKET; Clarence C. Sibley, Perth Amboy, N. J., and George A. Lutz, New York, N. Y. App. filed June 5, 1903. Details of an insulating plate used with a lamp socket. Has a neck projecting upward through the metallic casing and which is held thereto by a grooved portion containing a resilient ring.